MACHINERY

VOLUME 57 **AUGUST, 1951** NUMBER 12

The Monthly Magazine of Engineering and Production in the Manufacture of Metal Products

SHOP PRACTICE

Safety—The Keynote in New Oldsmobile Press Set-Up *By R. E. Hansen* 137
Machining Steel Molds for Curing Rubber Tires *By Albert Felton* 144
Hydraulic Fluids in Industrial Equipment *By George N. Dorr* 151
Why Taps Should Be Sharpened Precisely *By Edward Blake* 154
Forming and Fabricating Seamless Nickel Tubing 163
Transparent Cutting Oils Offer Important Advantages *By J. C. Van Gundy* 177

MACHINE AND TOOL DESIGN

Designing Carbide Dies *By M. J. Blackstrom and E. J. Reitler* 170
Quick-Acting Milling Fixture *By Irving Mansfield* 185
Attachment that Adapts a Drilling Machine for Lapping *By Gerhard Wenke* 185
Punch Press Feed Increased by the Use of a Sliding Pilot *By L. Kasper* 186
Cutters Designed for Machining Seats and Grooves in Air-Valve Parts *By Robert W. Newton* 187
Portable Hopper Type Container Facilitates Assembly of Balls *By W. M. Halliday* 189
Device for Locking Index-Plate in Any Desired Position *By Fritz L. Keller* 191
Knock-Off Ring Facilitates Removal of Work from Mandrel *By James J. Baule* 191
American Standard Dimensions of Guidepost Bushings for Punch-Press Die Sets (Data Sheet) 239

MANAGEMENT PROBLEMS

Keeping up with Washington *By Loring F. Overman* 133
Cooperation between Designers and Production Men Pays Off *By Charles O. Herb* 135
Higher Machine Tool Prices Permitted to Stimulate Production 162
The Sales Engineer and His Problems *By Bernard Lester* 192

DEPARTMENTS

Keeping up with Washington	133	The Sales Engineer	192
Engineering News	160	The Latest in Shop Equipment	194
Materials of Industry	182	Between Grinds	227
Tool Engineering Ideas	185	New Catalogues	229
Ideas for Shop and Drafting-Room	191	Product Information Service	229
		News of the Industry	232
		Data Sheet	239

Product Index 321-365

Advertisers Index 367-368

Editor
CHARLES O. HERB

Associate Editors
FREEMAN C. DUSTON
CHARLES H. WICK
GEORGE H. DeGROAT

Book Editor
HOLBROOK L. HORTON

Consulting Editor
ERIK OBERG

•

Published Monthly By
THE INDUSTRIAL PRESS
148 Lafayette St., New York 13, N. Y.

ROBERT B. LUCHARS
President

EDGAR A. BECKER
Vice-President and Treasurer

HAROLD L. GRAY
Secretary and Publishing Manager

•

Advertising Representatives
LOUIS PELLETIER
WALTER E. ROBINSON
DWIGHT COOK
148 Lafayette St., New York 13, N. Y.

GEORGE H. BUEHLER
228 N. LaSalle St., Chicago 1, Ill.

BOYCE TOPE
568 Maccabees Bldg., Detroit 2, Mich.

DON HARWAY & COMPANY
1709 W. Eighth St., Los Angeles 17, Calif.

Subscription rates: United States and Canada, one year, $4; two years, $7; three years, $8; foreign countries, one year, $7; two years, $13. Single copies, 40 cents. Changes in address must be received by the fifteenth of the month to be effective for the next issue. Send old as well as new address.

Copyright 1951 by The Industrial Press.

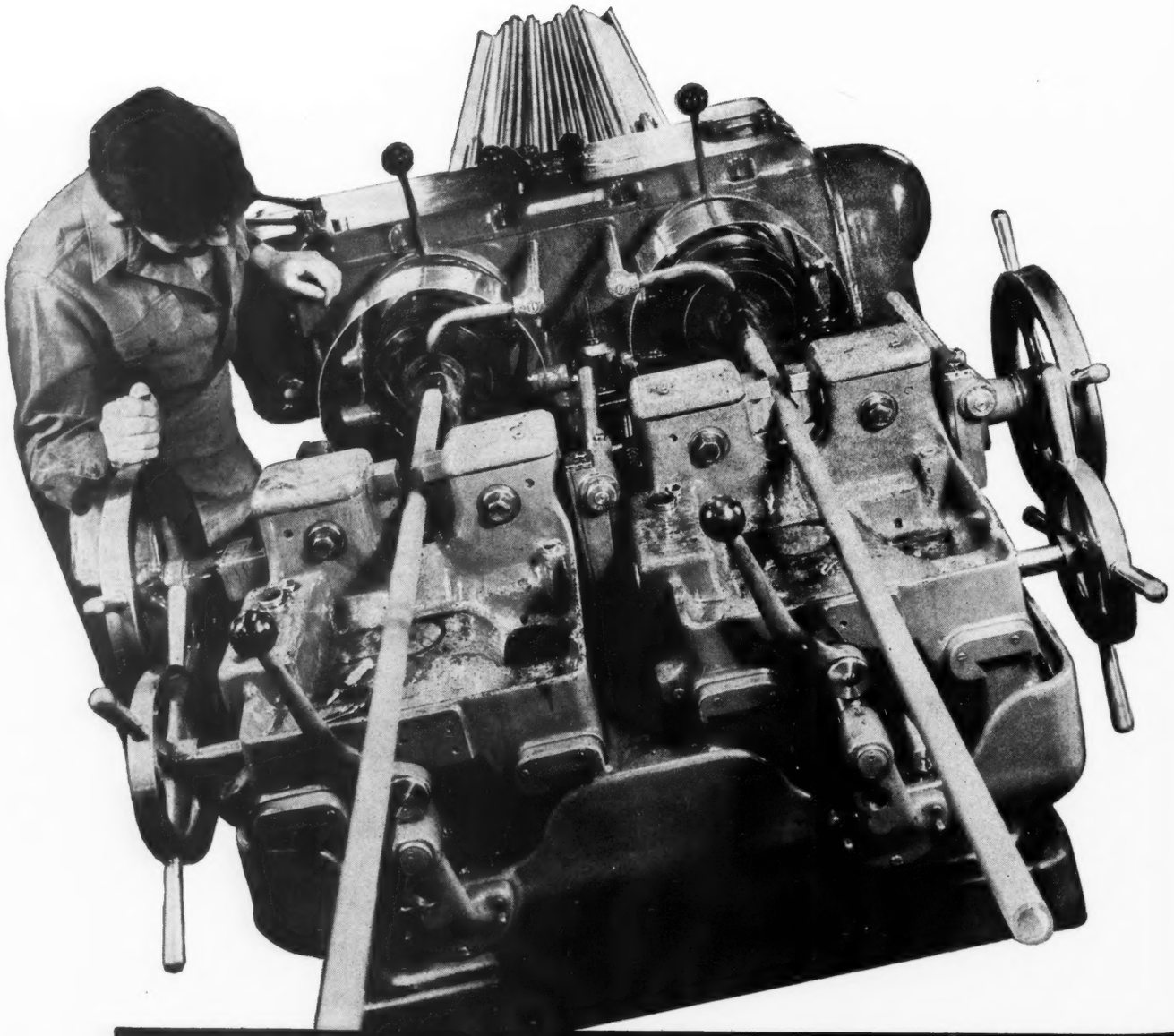
Entered as second-class mail matter, September, 1894, at the Post Office, New York, N. Y., under the Act of March 3, 1879. Printed in the United States of America.

British Address:
National House, West St.
Brighton 1, England

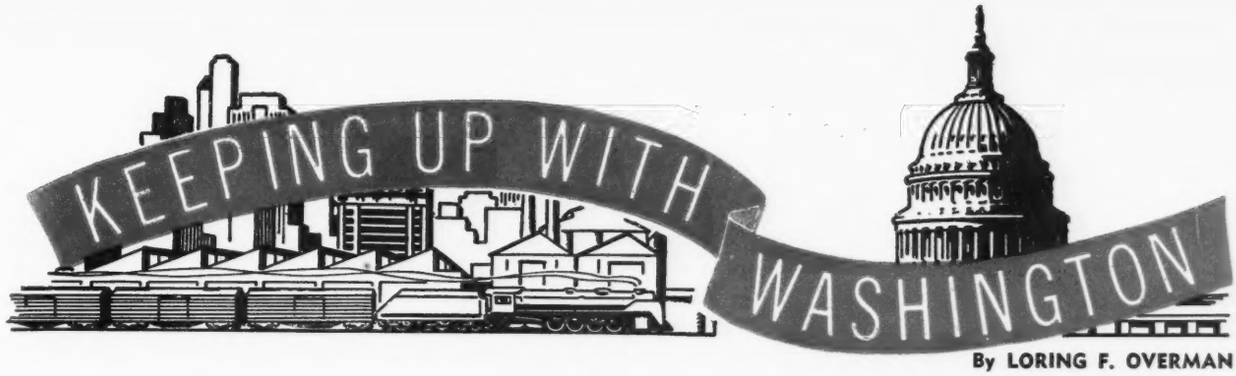
Total Distribution for July, 24,075

PRECIS

. . . threads cut



LANDIS *Machine* COMPANY



By LORING F. OVERMAN

Defense Program "Gobbling Up" Raw Materials, Production Facilities, and Manpower

NOT so long ago, ODM Director Charles Wilson figured that the defense effort would superimpose only 18 to 20 per cent on the nation's economy. The over-all figure has not been changed, but some of its components have. In the case of certain scarce metals, the entire supply is set aside for defense work. This has the effect of a complete shut-off of those metals to civilian enterprises.

The things that the National Production Authority says and does in the field of machine tools are significant. They provide the clue that Government planners are betting that the defense production will get a lot more active before it levels off to any sort of post-emergency level. "During the next few months," NPA says, "extensive expansion in machine tool production will be needed to meet increasing defense requirements. Sub-contracting to manufacturers with idle metal-working machines is considered more satisfactory to the Government than increasing machine tool builders' facilities."

With this in view, it has been announced that NPA has established an "information center" where manufacturers with idle metal-working machines will be notified of sub-contracting opportunities from machine tool builders. The center is a part of the Metal-working Machinery Branch of the General Industrial Equipment Division.

As in World War II, defense planners have already found that applying a control at one spot inevitably gums up the works at some other point along the line. For instance, with NPA insisting upon machinery manufacturers sub-contracting as much work as possible, it was found that the OPS had imposed rules making sub-contracting unprofitable.

As originally worded, the Machinery Manufacturers' Pricing Order (CPR 30) provided that a manufacturer may not add additional costs incurred through manufacturing or procurement channels which he did not historically employ. If he had formerly made the component in question in his own plant, but decided to sub-contract it in order to speed and expand his output, he found himself without a means of working out a price. If he continued to make the tool, he could include certain increases in manufacturing costs, but would not be permitted to pass along any extra costs resulting from sub-contracting.

Although wanting to cooperate with NPA to speed production, the OPS feels that such sub-contracting will usually be more costly than when done by the primary producer, particularly during early stages of the contract, when the new producer may insist upon covering himself amply in entering a different field. At press time, it seemed certain, however, that there would be a sub-contracting amendment to CPR 30, covering the machine tool field only.

The fact that everybody wants to "get into the act," in so far as the Controlled Materials Plan is concerned, is a further tip-off that the defense effort is cutting a widening swath in the national economy. As originally conceived, the Controlled Materials Plan was to siphon off only enough steel, copper, and aluminum to fill defense and defense-supporting needs. There was to be plenty left without ratings for the rest of the users of the three major metals. The odd thing about it is that when the "official" estimates came in from defense agencies and industry divisions, the quantities demanded as "musts" exceeded total supplies.

At present, the NPA is considering steps leading to a 100 per cent CMP in the fourth quarter of this year. The first step in that direction is that manufacturers of consumers' durable goods will be asked to file CMP forms for fourth-quarter production in order that full information will be available if it should be decided to close the "open end" of CMP. Forms were to be ready about July 1, to be returned by the end of that month. Information on those forms will tell how much materials will be needed by the consumers' durable goods industry and will help NPA to decide whether these manufacturers can operate in the free area outside the present CMP.

At every turn, NPA is trying to find out whether industry can produce more "if necessary." Meeting recently with the Gear Manufacturers' Industry Advisory Committee, NPA urged that the industry accept sub-contracts for the production of specified sizes and shapes of gears. Some producers reported that they would be able to handle such contracts shortly, while others said that they must first install equipment, which is not immediately available. The industry was assured that firms contracting to supply the types of gears required by the defense department would get priority assistance.

The industry group recommended that NPA guarantee that alloy steel be made available to small manufacturers who are unable to substitute other materials in making gears and who cannot order directly from the mills. Most gear plants do not have large enough capacity to satisfy both military and civilian demand. To meet both, more equipment is needed by some plants, while others will need to expand over-all facilities. The industry has a six to nine months' backlog of unfilled orders, with rated defense orders accounting for half of the total. The backlog is due to materials shortages, lack of manpower, and inadequate capacity.

Latest NPA wrinkle to speed the delivery of machine tools to defense contractors is a "Metal-working Machinery Diversion Directive." Under NPA Order M-41 (Metal-working Machinery), defense contractors are eligible to apply for aid in securing deliveries of machine tools if they are engaged in direct military or defense-supporting activities. Such contractors must also show that they have purchase orders for machine tools on file with a specific supplier, and have no idle capacity or equivalent production equipment available. Under such circumstances, they file NPA Form 76, which is a request to advance the delivery date of production equipment.

If NPA investigation indicates the case is a proper one, it issues the diversion directive. This would require a machine tool builder, or manufacturer of other metal-working machinery, to give priority to the order so evaluated.

CMP

and Ryerson Steel Service

As you know, the Controlled Materials Plan went into effect July 1. The full extent to which CMP will affect our own operations and those of our customers is difficult to predict. But as of July 1, we are required by law to give the following precedence to orders for steel from stock:

1. Orders backed by CMP directives. These emergency CMP allocations of steel by the National Production Authority get the highest priority, as they did under CMP during World War II. Since directives are primarily placed with steel producers, the warehouse tonnage involved may not be large, but the kinds and sizes are likely to be those most in demand.

2. Authorized Controlled Materials orders. These orders, authorized by Government Agencies or Industry Divisions under CMP, received second highest priority, and they will probably account for a larger proportion of warehouse steel. A typical authorized Controlled Material order might bear the allotment No. K2-3Q51 in which K stands for the Agency or Division making the allocation; 2 represents the specific program involved, and 3Q51 stands for the calendar quarter in which the authorization is valid. It should be noted that the symbol DO-K2, used in conjunction with the K2-3Q51 authorization, is extended only for the purchase of finished products, such as chain, wire rope, fastenings, etc., or for non-controlled materials such as plastic or babbitt, and is not used when ordering controlled material such as steel. Another important note: The NPA has just set up a blanket authorization to be used by manufacturers of certain products who require only small amounts of carbon or alloy steel for production purposes. The symbol employed is SU. For details see Direction No. 1 to CMP Regulation No. 1.

3. Orders bearing the old NPA DO ratings and calling for delivery before October 1, 1951. These orders bearing the DO symbol plus two digits such as DO-97 for Maintenance & Repair or DO-21 for Miscellaneous Defense requirements will remain valid during this change-over quarter, which ends October 1. Until then they have third highest priority.

4. Non-rated orders. With our tonnage considerably under last year and demand higher than ever, we may not be able to fill many of these non-rated orders—much as we would like to. For, of course, shipment depends on our having the steel in stock, no matter what the priority. But you can be sure that we will always do everything possible to help you get the steel you need.

★ ★ ★

IT IS IMPORTANT, therefore, that you give us the highest rating to which each order is entitled. And, in the case of oral or phone orders, be sure to send a written confirmation, including the rating which applies, within 15 days. As we are required to report all cases in which confirmation is not received, your cooperation on this point is important.

We appreciate the fact that many questions are bound to arise under the changing regulations prevailing today. So please remember that we are always glad to work closely with you on your steel procurement problems. Just call our nearest plant.

REQUIRED FOR CMP STEEL ALLOTMENTS. One of the following CMP Forms must be used by manufacturers filing with NPA for authorization of schedules and allotment of steel.

Form CMP-4A. For prime and sub-contractors of Class A products.

Form CMP-4B. For manufacturers of Class B products.

Form CMP-4C. For prime and sub-contractors engaged in construction work and for manufacturers of Class A products used in such construction.

In addition, you may find helpful information in CMP Reg. No. 4 which concerns the controls governing the steel warehouse industry. For copies contact the National Production Authority's regional or field office near you.

RYERSON STEEL

STEEL-SERVICE PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • DETROIT • CINCINNATI • CLEVELAND
PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO

Cooperation Between Designers and Production Men Pays Off

THE noted efficiency of the American metal-working industries has been due in large measure to the close cooperation that has generally existed between machine designers and production men. The designer habitually employs his ingenuity to develop machinery that will produce metal parts at the highest rate consistent with the required quality. He feels that usually there is one best way of doing everything, and he makes an effort to achieve that end with each problem that comes to his drawing-board.

After the machine is built, it is up to the production man to employ the new equipment to its utmost advantage. He proves the practicability of the equipment or uncovers "bugs" that prevent the machine from performing with the efficiency that had been anticipated by the designer. It is at this point that the theory of the designer is verified by the practical "know how" of the production man or runs counter to it.

Much money and energy have, however, been expended before the modern production machine reaches the floor of the user's plant, and it is therefore imperative that designers consult extensively with the production man who will employ the equipment during the time that it is still on the drawing-board. While this is fairly general practice, the opportunity exists for still greater cooperation than in past years. The matter is of vital importance right now, because the constantly diminishing supply of skilled mechanics necessitates increasing development of wholly automatic machinery.

The need for coordination of ideas is especially desirable in the development of single-purpose equipment, and particularly machine tools of the transfer type, which usually cost several hundred thousand dollars apiece. Whenever possible, adjustments and other provisions should be made that will permit the work to be handled despite modifications in it that may be dictated by market or other requirements. Also, whenever modifications of the work-piece are necessary, the designer should consult the production man to make sure that existing manufacturing equipment will still be able to handle the job. Modifications become prohibitive if they make a machine tool obsolete.

There is one common point of conflict between designers and production men that seems to come up with every war or national defense effort. That is the feeling of production men that the designers of ordnance, aircraft components, and other parts of fighting equipment customarily specify tolerances much closer than are required by the function of the part. Designers of such equipment should realize that every additional 0.0001 inch, or even 0.001 inch, means higher cost and slower production.

The basic knowledge of machine designers and production men should be similar, so that each will understand the problems of the other. It is on this premise that the editorial pages of MACHINERY are constructed each month—to meet the needs of both the designer and the production man, whose jobs are so closely interrelated.

Charles O. Herb

EDITOR

nothing else can do what Microcarb does!

Microcarb is a control system for the carburizing process. It *continuously* measures something that nobody has ever measured before—the active carbon in a production furnace's atmosphere *while the furnace is at work in the heat-treat department.* And it automatically, continuously controls the surface carbon content of the steel on the basis of this measurement.

Microcarb is many things to many men, especially in defense work.

To top management, Microcarb means both higher product quality and lower unit cost! Also, it means that still another manufacturing operation comes under automatic control.

To production executives, Microcarb means closer following of manufacturing schedules, because carburizing speed and results are more predictable. More predictable, that is, even than with our own pre-Microcarb processing installations. And Microcarb helps heat-treaters apply their skill—helps them earn incentive pay.

To metallurgists, Microcarb means simply better carburizing. Perhaps you saw a recent magazine advertisement headed "Thank You, Leeds & Northrup!" in which Indiana Gear Works credits Microcarb as a "big help to the gear industry" and says

> "now, for the first time, we are able to control case carbon content on carburized parts"
>
> ". . . we can produce carburized surfaces with absolute uniform control and obtain absolute maximum hardness and maximum ductility"
>
> "no more retained austenite on wearing surfaces of high nickel steels"
>
> ". . . no more carbide networks in the hypereutectoid zone"

Such results trace back to the fact that with Microcarb the carbon you "set" is the carbon you get. Just as you set a temperature controller at 1700 F, if that is the carburizing temperature you want, so you set the Microcarb Controller at 90 if you want to carburize to ninety carbon. By making the proper setting, you can either protect the surface or add carbon. Instead of controlling the amount of carbon material supplied to the process, you actually control the amount that does the work. Can you imagine controlling the temperature of a furnace by just measuring the amount of fuel it gets, without a pyrometer to tell the temperature directly? Well, that's the kind of carbon control you have always had—until Microcarb. Microcarb measures and controls carbon directly, just as a pyrometer measures and controls temperature directly.

The "reason why" for Microcarb is its carbon-detecting element. This instrument, called a Carbohm, is an engineering rarity—a truly new device for sensing a change in its surroundings. Basically, it's a wire, made of an alloy which will either absorb carbon from the furnace atmosphere, or lose it to the atmosphere, until it and the atmosphere are in equilibrium, carbon-wise. With every change in the wire's carbon content, there's a change in its electrical resistance. This resistance is measured and translated into carbon percentage by the Microcarb recorder and controller.

Only Homocarb Furnace equipments of our new Series H can be used with Microcarb Control, because engineering to meet the needs of atmosphere regulation is a necessity. Specific features are a soundly designed electric furnace with solid-bottom retort, improved fan housing and work support, and aerodynamically designed discharge jets; and Micromax temperature control of the duration-adjusting type specially designed for this service.

Let us send you further facts about this new Microcarb development. Ask our nearest office, or 4921 Stenton Ave., Phila. 44, Pa., for Catalog T-623.

LEEDS NORTHRUP

TD4-623(3)

Safety THE KEYNOTE IN NEW OLDSMOBILE PRESS SET-UP

By R. E. HANSEN
General Supervisor, Production Engineering Sheet Metal
Oldsmobile Division, General Motors Corporation
Lansing, Mich.

THE closest possible approach to complete safety was the objective in a new installation of six presses at the Oldsmobile axle plant. This row of presses is employed to draw, form, and pierce flanged bearing retainers for the rear-axle housings. Outstanding material-handling methods have been combined with the latest safety practices through teamwork between tooling and methods engineers, safety inspectors, and production men.

The practically foolproof installation includes complete guarding at both front and rear of the presses without hindrance to the operators. Automatic feeding and ejecting mechanisms, "Iron-Hand" unloading devices, and specially designed work-holding tongs are features of the set-up. Mechanical elevators automatically carry the parts from one press to another, and from the final press into a washing machine. Push-button controls are provided at all four corners of each press, and limit switches stop the presses automatically in case of failure.

Magnesium safety blocks are placed on the beds of the presses to prevent the rams from

falling during set-up or inspection. Special attention has been given to preventing parts from working loose due to vibration. For example, cotter-pins and lock-washers are provided on the motor hold-down bolts. Also, a safety cable connects each motor to the frame or to some other rigid member of the press. Although the initial installation of all these safety features is expensive, it is firmly believed that they quickly pay for themselves by permitting faster production and relieving the minds of the operators. With such devices, the presses can be run continuously at high speeds.

The flanged bearing retainers, usually made from forgings, are completely formed from flat steel blanks on the line of six mechanical presses. These presses, made by the Cleveland Punch & Shear Works Co., are of three different sizes—the first and fourth being rated at 125 tons capacity, the second and fifth at 250 tons, and the third and sixth at 300 tons. The blanks, 6 1/8 inches in diameter by 0.265 inch thick, are stamped from sheets of pickled and oiled, extra deep drawing quality, hot-rolled steel, 18 1/8 inches wide, on a press prior to arriving at the line of presses that form the completed part. The steel used is a modification of S A E 1010, containing from 0.05 to 0.15 per cent carbon.

Successive shapes produced in transforming the flat blank into the finished bearing retainer are shown in Fig. 1. In the first drawing or cupping operation, performed on a 125-ton single-action press seen in Fig. 2, the flat round blanks are stacked in a magazine. The magazine and loading area is completely guarded, so that there is no danger of the operator's getting his hands near the die or ram. The lowermost blank in the stack is automatically transferred from the magazine to the die, and a drawn cup is ejected from the die with each stroke of the press ram.

This automatic feeding and ejecting mechanism can be seen in Fig. 3, which is a view taken from the back of the press with the rear guard temporarily removed. A stack of blanks *A* is shown in the stationary magazine *B*, and a drawn cup is seen at *C*. Arm *D* is hinged to the under side of the ram, and is connected by a knuckle-joint to lever *E*. Lever *E*, in turn, is pinned to shaft *F*. Thus when the press ram is raised or lowered, the movement of arm *D*, acting through lever *E*, causes shaft *F* to rock and imparts a reciprocating movement to slide *J* through levers *G* and *H*, which are also pinned to shaft *F*. The limit switch *K*, mounted on the side of lever *E*, provides for automatically stopping the press in case the feeding mechanism should not operate. A plunger on the switch contacts a cam surface at the end of shaft *F* and permits the ram to descend as long as the shaft rotates. If the shaft fails to rotate for any reason, the current is interrupted and the press stops.

When the ram descends, slide *J* is pulled toward the back of the press, thus transferring

Fig. 1. Successive shapes formed from a flat blank 6 1/8 inches in diameter by 0.265 inch thick, in producing flanged bearing retainers for axle housings

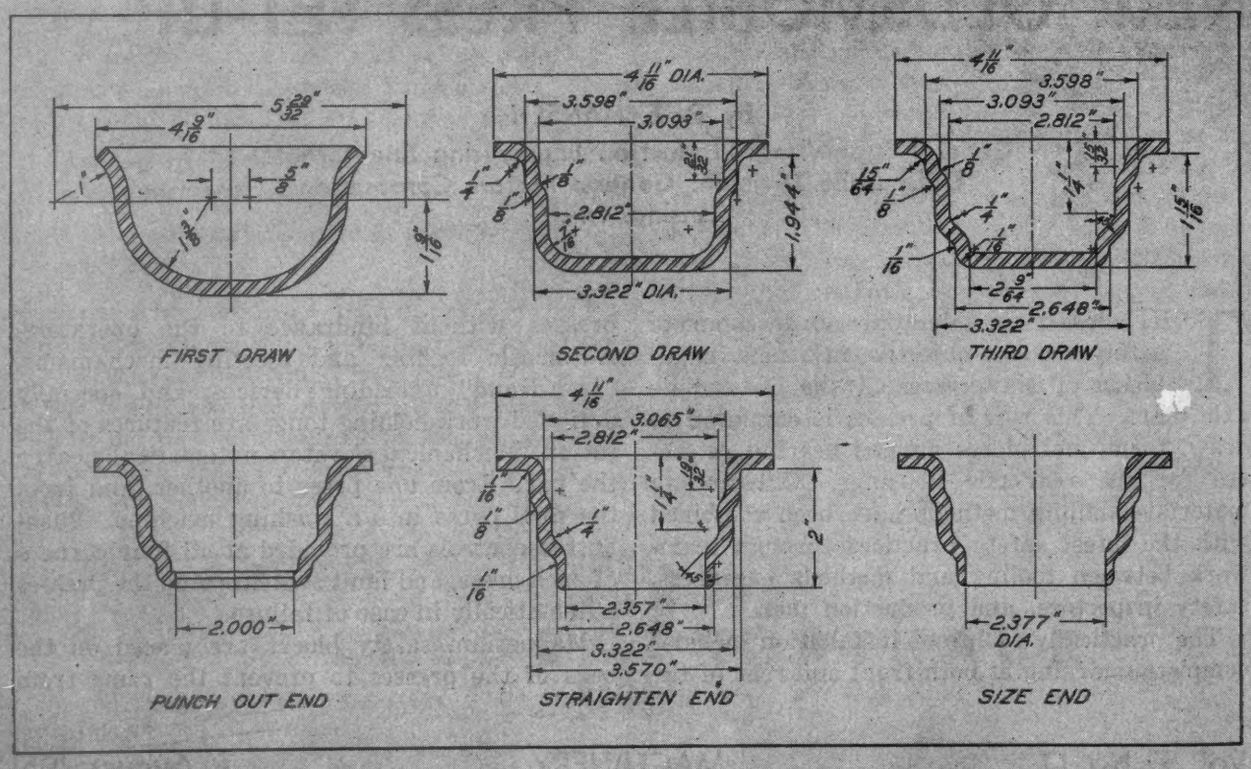


Fig. 2. A completely guarded, 125-ton mechanical press is employed for the first drawing or cupping operation on the round flat blanks

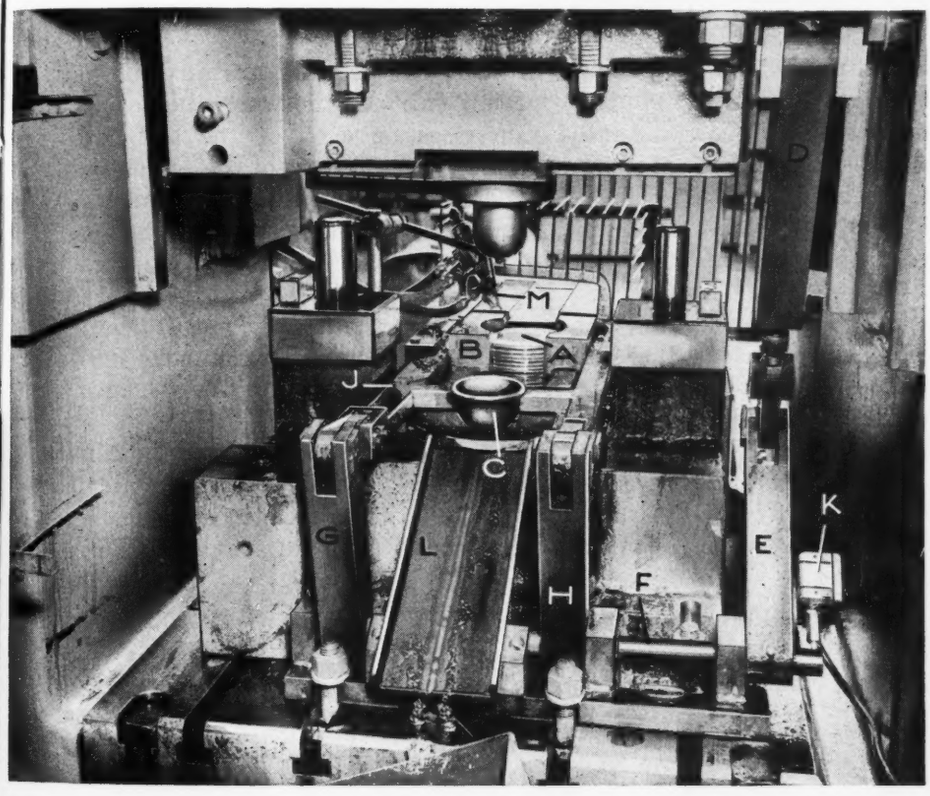


Fig. 3. Automatic mechanism that feeds flat blanks, one at a time, into the die and pushes drawn cups out

the bottom blank in the stack from the magazine to the die. Simultaneously, a drawn cup that is raised from the die by an air-actuated knock-out pin is carried back by the slide until it falls down chute *L*. When the ram is raised, slide *J* returns to its original position and picks up another blank. In this way, the press can be operated on a continuous repeating cycle. Each blank is automatically coated with a drawing oil applied by means of spray gun *M*.

Sectional construction is employed for all the dies used in forming the retainers. The die insert is shrunken by lowering its temperature, and then allowed to expand within the die ring. No mechanical method of holding is necessary, since the stresses set up in shrink fitting are sufficient to hold the die insert firmly in place. In this way, "down" time is reduced to a minimum, as the die ring and insert assembly can be quickly removed for maintenance. Also, the insert can easily be pressed out of the assembly and replaced, when worn, with a new or reground insert. Considerable tool steel is thus saved, since only the inserts need be replaced.

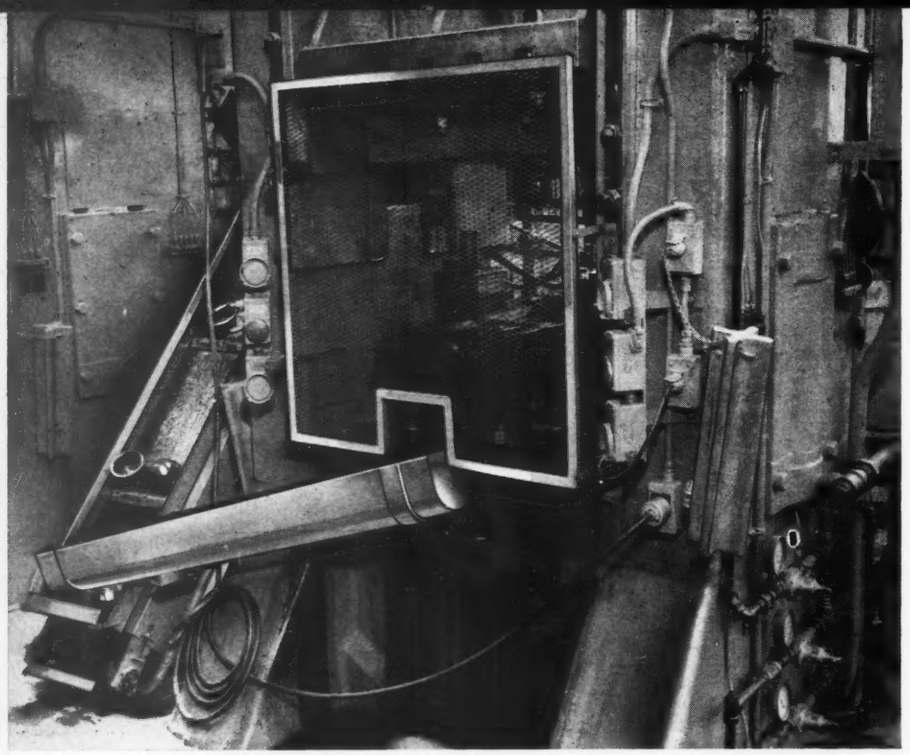


Fig. 4. Rear view of press shown in Figs. 2 and 3 with safety guard in place. Drawn cups are carried to next press by mechanical elevator seen at left

Fig. 4 shows a rear view of the press illustrated in Fig. 2, with the safety guard in place. The push-button controls, which are provided at all four corners of the press, as mentioned, can be seen both in Figs. 2 and 4. The magnesium safety block, used during the set-up to prevent the ram from falling is shown at the right in Fig. 4, attached to the press.

Drawn cups fall from the chute into a trough, and roll from there into a mechanical elevator at the left. These elevators, provided beside each press, carry the parts upward and drop them into a hopper at the front of the next press. The operators pick up parts from the hopper and place them in the dies by means of specially designed tongs (see the heading illustration). Openings in the press guards are just large enough to permit entry of the work and tongs.

As the ram rises on each of the last five presses, the part is stripped from the punch by spring-actuated knock-out pins, and falls onto a mechanical unloader, or "Iron Hand," Fig. 5, that is swung into position by means of levers attached to the ram. When the ram descends, the "Iron Hands" automatically swing toward the back of the presses, dropping the parts into troughs, from which they roll onto the mechanical elevators.

All of the "Iron Hands" are identical, and can be easily fitted to any of the presses. Another feature of the installation is that the gaps or die openings and platen sizes of all six presses are

Fig. 5. A mechanical unloader or "Iron Hand" is employed on five of the six presses to remove the formed parts from the die area

Fig. 6. Final forming operation on the flanged bearing retainers – sizing of bore at pilot end – is performed on a 300-ton single-action mechanical press

the same, having all been built to JIC standards. This permits interchanging the dies in case of a press breakdown.

Slugs punched out of the ends of the cups in the fourth press are salvaged and used for another automotive part. In the final operation, performed on the press seen in Fig. 6, the flanged bearing retainers are restruck, sizing the bore at the pilot end to a diameter of 2.377 inches. While all the presses are run on a continuous stroking cycle, the operators can place them on a manual stroking cycle at any time. The presses operate at twelve strokes per minute. Each operator periodically stops his press—generally three times in an eight-hour shift—to inspect the work so as to be sure that the dimensions are correct.

Completely formed retainers fall from the "Iron Hand" on the sixth press onto a mechanical elevator that carries them into an automatic three-stage washer, Fig. 7. In the first stage of the washing machine, the retainers are washed, and in successive stages, they are rinsed and dried.

A flanged bearing retainer is joined to each end of the rear-axle housings on the submerged-arc welding machine illustrated in Fig. 8. The operator of the welding machine removes two retainers from the hopper at the left, and places them on rotary pilot units at each end of the machine. An axle housing, lifted from the gravity roll conveyor at the lower right, is then placed on the centrally located equalizing unit

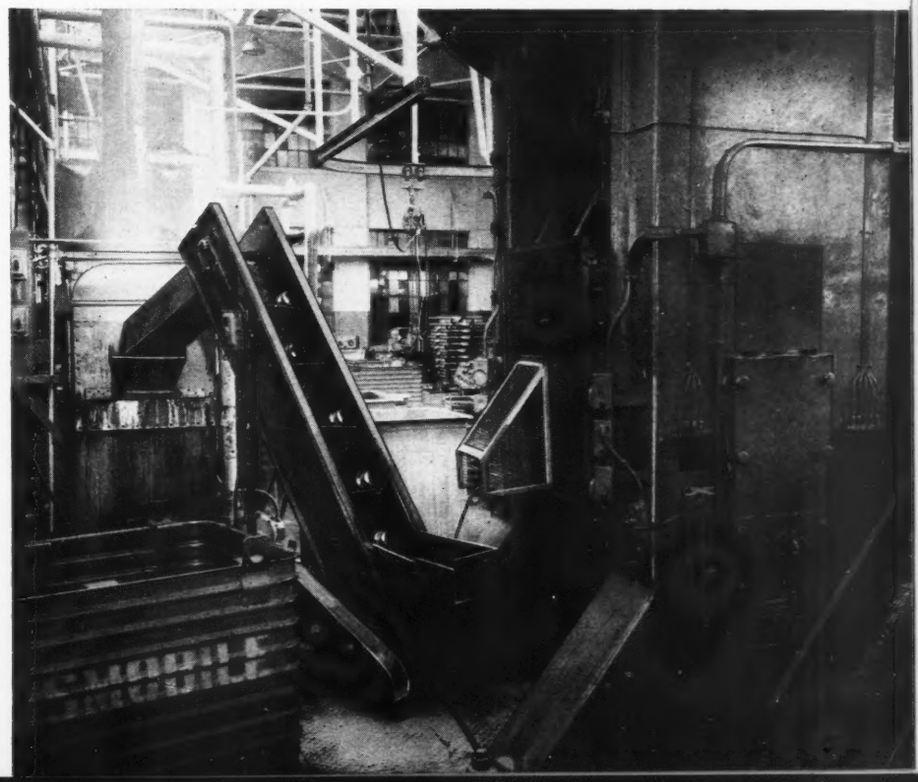


Fig. 7. A mechanical elevator carries the completely formed retainers from the final press to an automatic washer

Fig. 8. Automatic submerged-arc welding machine which joins bearing retainers to both ends of rear-axle housing simultaneously

of the machine, which locates the housing from the center of the banjo opening.

Two push-buttons are now depressed to actuate hydraulic cylinders, which push the retainers into the bore at both ends of the housing. Axial location of the retainers in the housing is governed by air orifice control. Air blasts are directed at right angles to the axis of the retainers, and, before the machine can operate, the retainers must enter the bore of the housing a sufficient distance to permit the blasts to enter the air receivers.

After the retainers have been assembled to the housing, the two submerged-arc welding heads are lowered into position, and continuous welds —each approximately 8 5/16 inches long—are completed as the housing and retainer assembly makes one revolution in 0.33 minute. The welding is performed with reverse polarity current at 430 amperes and 28 volts, a 1/8-inch diameter mild steel wire being automatically fed to the heads as required. Flux (Lincoln Electric Co. 780 grade, 200 grain size) falls from overhead hoppers and covers the electrodes—as seen in Fig. 9—during welding. The flux then falls into hoppers below the work, and is automatically carried to the upper hoppers to be used again.

The welded assembly is machined on a Greenlee double-end, six-station automatic indexing machine (Fig. 10). At the first station, the assembly is loaded with the banjo face of the housing resting on two pads for radial location.

Fig. 9. Close-up view of one submerged-arc welding head on the automatic machine illustrated in Fig. 8. The two 8 5/16-inch long welds are made in 0.33 minute

Fig. 10. Assembled bearing retainers are bored, faced, drilled, reamed, and tapped on a six-station automatic indexing machine

Equalizing V-jaws, actuated by a hand-lever and a worm-drive, clamp the peripheries of both bearing retainers. Another lever-actuated gear drive moves cams against the face of the banjo opening for endwise location.

When the drum indexes, carrying the properly located and clamped part to the second station, heads at both ends of the machine are advanced at the rate of 3 inches per minute (0.0075 inch per revolution) to rough-bore and chamfer the retainers. Both left- and right-hand boring heads are rotated at 396 R.P.M., corresponding to a mean surface speed of 400 feet per minute. Each head is equipped with three solid carbide tools, two for rough-boring different bearing surfaces (2.842 and 3.100 inches in diameter), and one for chamfering. Also, each head is equipped with a tool-block carrying a single carbide-tipped tool, which is fed inward (radially) by cam action to face the flange.

At the third station, the two bearing surfaces in each retainer are semi-finish-bored. The left- and right-hand heads at this station are rotated at 153 R.P.M. (125 surface feet per minute), and fed at the rate of 0.0075 inch per revolution. Each head is equipped with four high-speed steel tool bits, spaced 90 degrees apart, two tools being employed for each bearing surface.

Four holes, 23/64 inch in diameter, are drilled through the flanges by means of the two heads located at the fourth station. The drills are rotated at 637 R.P.M. (60 surface feet per minute), the feed rate being the same as with the previous heads. The drilled holes are chamfered at the outer face of the flanges by tools mounted on the heads at the fifth station. At the same station, an angular head, mounted at the rear of the machine, is employed to drill a 0.386-inch diameter breather hole in the axle housing. This drill is operated at the same speed and feed as the other drills.

At the sixth station, the breather hole in the housing is threaded with a 7/16-20 tap mounted on an angular head, and the four holes in each flange are reamed to a diameter of 0.3776 inch by the left- and right-hand heads. The reamers rotate at a cutting speed of 40.3 feet per minute, and the taps at 35 feet per minute, while the feed for the taps is 15 inches per minute, and for the reamers, 3 inches per minute. At the next indexing of the drum, the assembly is carried back to the first station for unloading.

A unique feature of the angular heads mentioned is that each head carries two spindles, only one of which operates at a time. Two different model housings in which the breather-hole locations vary are handled on this machine, and the two spindles enable the holes to be automatically drilled and tapped in the proper location in each type without changing the set-up.

Ample chip clearance is an important consideration in boring S A E 1010 steel, and considerable experimentation was necessary before the proper clearance could be obtained in this operation. Speeds of the heads at the second station were varied from 250 to 600 feet per minute, and feeds from 1 to 20 inches per minute in making the experiments.

The rough- and semi-finish bored bearing surfaces are subsequently finished on an Ex-Cell-O two-way precision boring machine. From 0.017 to 0.023 inch of stock is removed in this operation, and the bores are held to a tolerance of 0.0015 inch.

Procedure Followed in Manfacturing a Mold for a Super-Traction, Non-Directional Truck Tire. Such Molds Weigh up to 18,000 Pounds and Require as Many as Fifty Different Operations per Mold Half

By
ALBERT FELTON, Mold Engineer,
The B. F. Goodrich Co.,
Akron, Ohio

STEEL molds for curing or vulcanizing rubber tires used on airplanes, trucks, automobiles, and other vehicles require as many as fifty different manufacturing operations, taking a total time for each mold half of up to 800 man-hours. The molds for tires that range from the 4.00- by 8-inch size up to the huge 21.00- by 29-inch tire vary in weight from 200 pounds to 9 tons.

At the B. F. Goodrich plant in Akron, more than 43,000 square feet of floor space is devoted to the manufacture of approximately 3500 tire molds per year. High quality tire molds are necessary to provide an economical vulcanizing life and produce good tires. Close dimensional accuracy must be maintained, and a smooth surface finish is necessary to produce a balanced tire having sharp detail.

For many years, tire molds in general were made from chilled cast iron. However, molds for solid, smooth-thread tires were sometimes made from cast steel to avoid the excessive weight and size required for cast-iron molds of equal strength. Although cast-steel molds were more

Machining Steel Molds for Curing Rubber Tires

desirable because of their smaller size, lower cost, and the fact that more molds could be placed in each vulcanizer (curing presses were not in use then), it was impossible, in the early days of the tire industry, to produce suitable cast-steel molds for tires having a tread design.

This was due mainly to the fact that the art of steel casting had not progressed to the point where sound castings could be produced consistently. Such castings could be used for smooth-tread, solid tire molds because any porous spots or holes could be easily plugged and refinished to conform to the cavity. Also, foundries in those days persisted in using ordinary machine steel containing 0.30 per cent carbon, and such castings did not provide the free cutting characteristics nor quality of finish required in tire molds.

The successful use of steel for tire molds dates from 1926, when forgings of a free-machining, high-sulphur, screw machine steel were made available to the industry. With few exceptions, the B. F. Goodrich Co. has used either forged or cast steel for making tire molds since that time.

In the following description of the mold manufacturing processes employed in the B. F. Goodrich shops, the mold used to vulcanize 11- by 20-inch, super-traction, non-directional military truck tires has been selected as representative. It will be understood that the number and complexity of the operations vary with the size and design of the tire. Molds for this particular tire are cast from a modified S A E 1126 steel, each mold half measuring approximately 51 1/2 inches in diameter by 6 1/2 inches thick and weighing about 1540 pounds. The castings have a Brinell hardness of about 165.

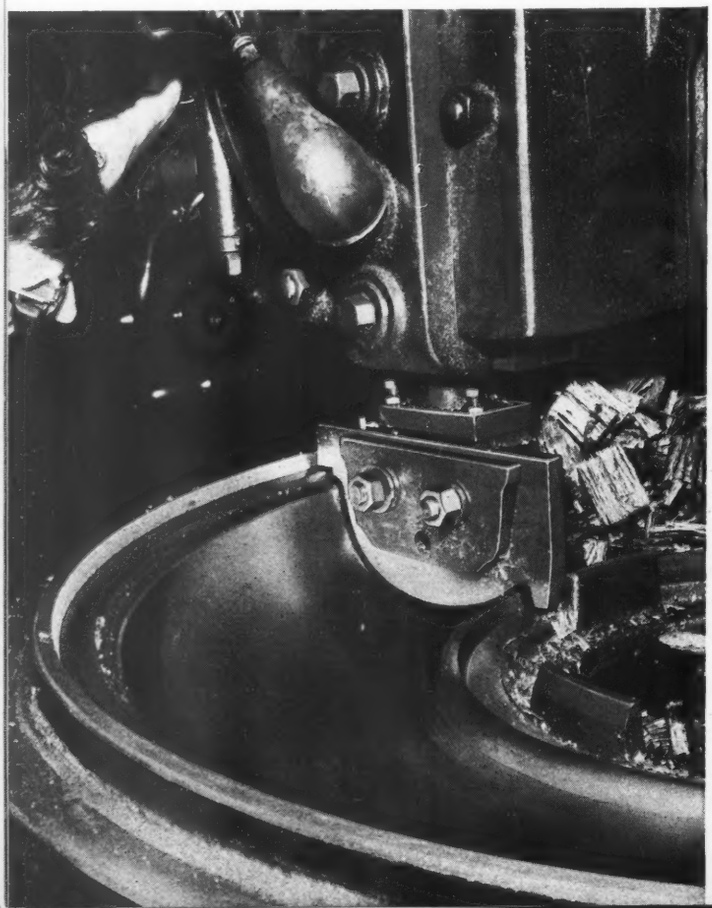
The first operation, performed on a vertical boring mill, consists of rough- and finish-facing the back of the mold casting to produce a flat locating surface for subsequent machining operations. At the same set-up, the outside diameter of the mold body (between the flange and the back face) is turned to provide for chucking, and the periphery of the 1 1/4-inch wide flange is turned. The mold is set down squarely on four jacks of suitable height, and gripped by means

Fig. 1. The cavity and other surfaces on cast-steel tire molds are rough-formed, faced, and turned on a vertical turret lathe

Fig. 2. A "semi-profile" tool is used to shape the tire mold cavity before it is rough-formed by tool seen at left in Fig. 1

of a four-jaw chuck, which clamps against the inside cavity of the mold. As much as 1/2 inch of stock is removed from each of the three surfaces machined at this set-up. The casting rotates at a maximum surface speed (on the periphery of the flange) of 300 feet per minute, and the carbide-tipped tools used are fed at rates varying from 0.017 to 0.031 inch per revolution.

The mold casting is removed from this machine, turned over, and then placed on level jacks and chucked on the rotary table of a 54-inch vertical turret lathe (Fig. 1). On this machine, the contour cast on the front of the mold half—including the cavity, center-line land, bead land, guide lugs, ring-guide surfaces, etc.—is rough-formed, faced, and turned.



When only a few molds are required, the cavity is roughed out by means of a round-nose tool, the operator developing the desired contour by adjusting the cross and vertical feeds. If eight or more molds are needed, however, a rough-forming tool (seen mounted on the ram head at the left) is made for this operation, and the molds can be machined closer to size than is possible with a round-nose tool. In such cases, a so-called "semi-profile" tool, as seen in Fig. 2, is used to rough out the cavity before cutting with the form tool.

From 0.015 to 0.030 inch of stock, left on the various surfaces after rough-forming, is removed in a third operation performed on a 54-inch vertical boring mill. A close-up view of the form tool used on this machine to finish the cavity is seen in Fig. 3. This large form tool is made from a special high-carbon steel blank, 6 1/2 inches wide by 13 inches long by 1 1/4 inches thick, ground to the desired contour with a 12-degree relief angle in back of the cutting edge.

Weights are clamped on the back face of the tool to prevent chatter during machining. The tool is bolted to a special holder mounted in the ram of the vertical boring mill. Two set-screws

Fig. 3. Close-up view of the large form tool used to finish-machine the cavity, bead land, and center-line land of the tire mold

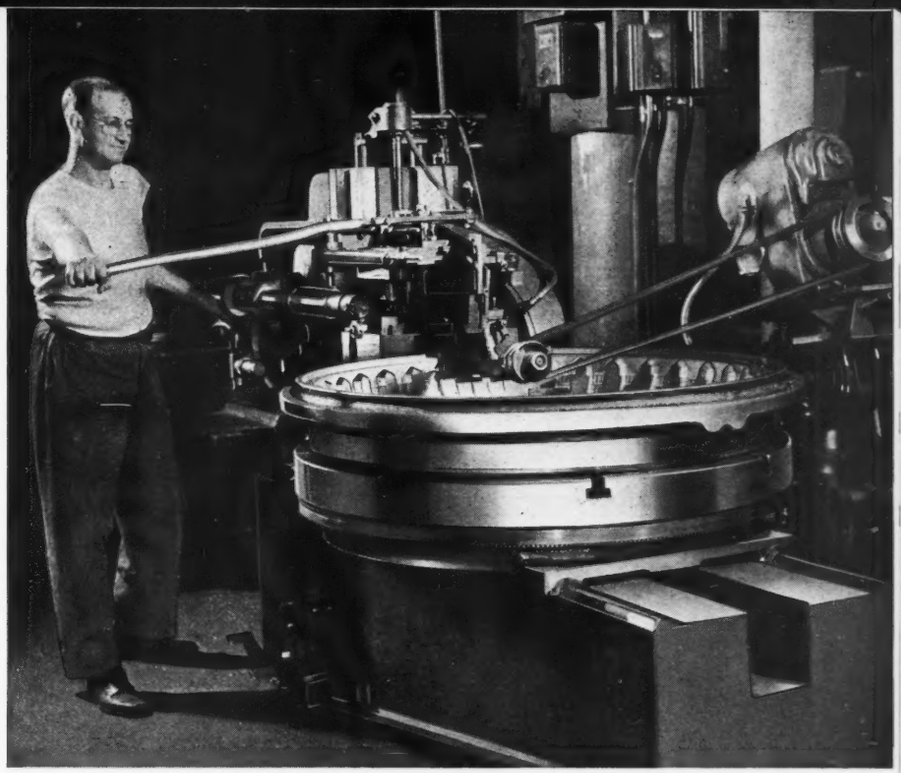


Fig. 4. "Skid" engraving machines have a rotary table, on which the mold casting is mounted, and a cam-controlled cutter-spindle

are provided on the holder to adjust the tool by pivoting. In setting up, it is essential that the vertical plane of the form tool face pass through the center of the mold casting.

Registry surfaces for aligning the mold halves when they are brought together in the tire curing machine are finish-machined in this set-up, as well as the side-wall and bead corrugations. The distance between registry diameters on each mold half must be maintained within ± 0.003 inch. The size of the tire and the order number are hand-stamped on the land of the mold before it is removed from the machine.

Tread, bank, and side-wall designs for the tire are cut in the mold cavity on specially designed engraving or routing machines of the type seen in Fig. 4. These so-called "skid" machines have a rotary table, on which the mold casting is mounted, and a cam-controlled cutter-spindle.

The camshaft, which is geared to the table drive-shaft, is rotated by a handwheel located at the left hand of the operator. The ratio of the gearing between the camshaft and the table drive-shaft can be changed to suit the indexing required for different pitch treads. A follower is kept in contact with the rotating drum or cylindrical cam by means of a lever held in the operator's right hand. Straight-line motion of the cam follower is converted into radial motion of the cutter-spindle through linkage and spring-steel bands.

The cutter-spindle, which is belt-driven from a variable-speed electric motor mounted on a stand in back of the machine, is suspended from

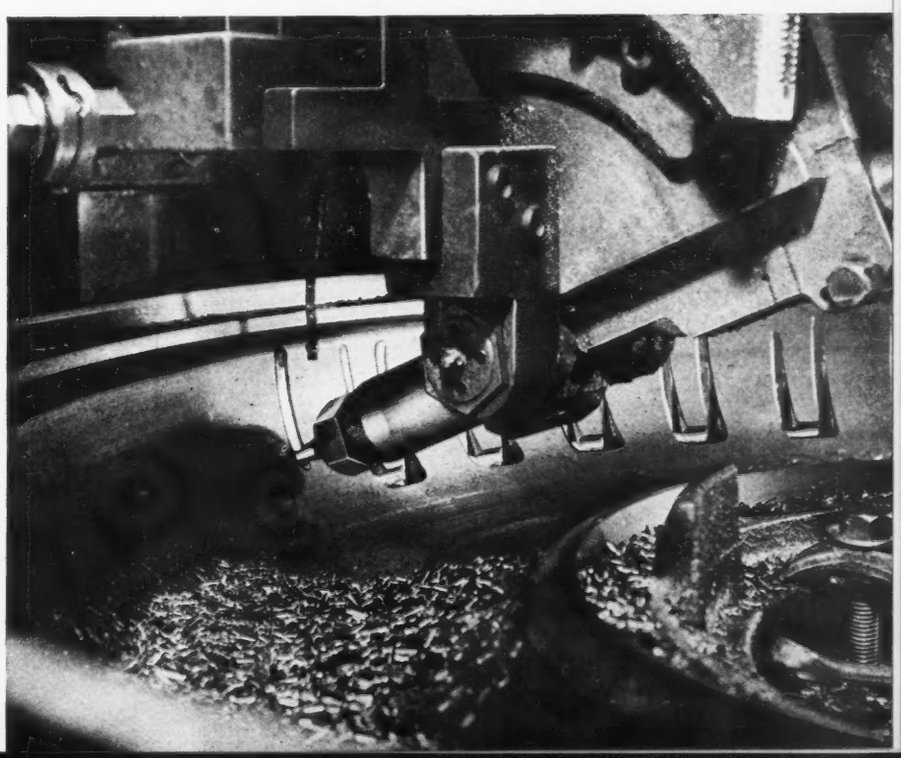


Fig. 5. Tread design for the tire is cut in the mold cavity on specially designed engraving machines called "skid" machines

Fig. 6. Pneumatic hammers equipped with chipping tools are used to round and blend various surfaces in the mold cavity

an arm held on the vertical column of the machine. Considerable adjustment is possible to accommodate different size molds or vary the radius or depth of cut by moving the arm up or down on the column, pivoting the cutter-spindle about its center, or sliding the whole spindle and quill assembly into or out of its holder.

The spindle, which is generally rotated at about 3000 R.P.M., is equipped with a collet for holding the two-lip, high-speed steel routing tools. Lip widths and radial clearance on the tools are critical, and the tools are tapered at an angle of 8 degrees. The tapered surface thus produced facilitates removal of the tire from the curing mold.

The design and manufacture of cams for the skid machines is the most important step in tire-mold production. Extremely accurate lay-outs and considerable calculation are necessary in designing the cam, and lay-outs of both the side-wall and tread designs must be made. The accurately made drawings, either single or double scale, must include one complete pitch of the side-wall and tread designs, the center line of the cutter travel, and all design lines necessary to transfer the cutter center points to the cam.

The cutter center points, when transferred to the cam, become follower-pin center points. The follower pin will therefore limit the travel of the tool to the desired tread design path. Various sized follower pins are employed, the diameter of the pin being made slightly larger than the cutter diameter to allow for stock to be removed in finishing (generally about 0.010 inch on the diameter, or 0.005 inch per side).

The circumference of the cylindrical cams employed on skid machines is 10.240 inches; so the cam design drawing—if full size—is cut off to this exact length and wrapped around the periphery of a blank steel cam. The paper is then prick-punched at the required points. When the lay-out has been completed, the drawing is removed and the cam machined. From two to six-

Fig. 7. Steel burrs, mounted on flexible-shaft machines, smooth the surfaces, removing any marks or sharp edges produced by chipping

Fig. 8. Tread surfaces in the tire mold are polished smooth by means of emery cloth held on the end of a flexible shaft

teen cams are required for any particular mold, depending on the tread design (whether it is of variable pitch, etc.) and the amount of stock to be removed. For the tire described, which is of constant pitch design, only one cam and one set of gears are required for each of the three operations in engraving the mold.

Tread cutting operations in the mold cavity for the 11.00- by 20-inch military tire are completed on three skid machines. On the first machine, Fig. 5, the outline of the tread design is shaped, and then the material within these rib outlines is routed out in six cuts, the depth of cut being increased in each successive operation. Maximum depth of cut is about 0.670 inch below the surface of the mold cavity.

On the second skid machine, the design required on the side-wall of the tire is cut in the mold cavity. Finally, the side-wall design and the tread design are blended together on the third machine, seen in the heading illustration. Template gages, as shown, are used to check the widths of the ribs.

Finishing operations are performed in a separate department by highly skilled workers, using portable electric, pneumatic, and hand tools. In the first finishing operation, Fig. 6, the work is mounted at an angle in a specially designed vertical stand equipped with rolls on which the mold can be rotated by hand. Here the sharp edges are rounded, radii are blended, and corners that could not be satisfactorily reached by the routing tools are chipped out by means of portable air hammers. An assortment of six chisel-steel chipping tools of various weights and shapes is used, and about four hours is required to complete each mold half.

The tire mold is then transferred to a revolving-top horizontal stand, Fig. 7, where steel burrs, mounted on flexible-shaft machines are employed to remove any chip marks or sharp edges remaining and further blend the radii. From eight to twelve different shape burrs are

Fig. 9. Radial slots are sawed in the registry surface of the tire mold to allow air to escape during curing

used on each mold half. The tools are rotated at from 1750 to 3600 R.P.M., and this surface smoothing operation is completed in about three hours. Following the burring operation, air hammers are used once more to "pound" the various surfaces in the mold cavity. "Pounding" removes the tool marks, closes up any tears, and makes the surface more dense, thus facilitating subsequent polishing. The pounding tools, made from chisel steel, have blunt ends of various shapes, which are roughened periodically with a hand file. About six different shaped pounding tools are required for each mold.

Flexible-shaft machines are also used to smooth and polish the tread surfaces in the mold, as seen in Fig. 8. A high degree of finish is essential for producing smooth tires of good appearance, free from surface defects. This finish is achieved by the use of industrial emery cloth of 36 to 80 grain size. An even finer abrasive (up to 240 or 320) is employed on molds for white side-wall tires. The emery cloth, received in rolls, is cut into strips and wrapped around the flexible-shaft tool as shown, or punched into discs, which are held and rotated against the work surface by rubber caps on the end of the flexible shaft. The polishing of the molds, which requires from ten to twelve hours, is the longest and most expensive operation performed on these parts.

To sharpen the details of the tire tread, all lines in the mold cavity are straightened, made an even depth, and more clearly defined by "pounding" with hand- or air-hammer actuated "broaching" tools. A final finisher then carefully inspects the mold and uses abrasive cloth or hand "broaches" to remove all blemishes. This operator also drills the eight tapered side-wall vent holes that allow trapped air to escape when the tire is being cured. A flexible-shaft machine is used to rotate the 3/32-inch diameter drill and the taper reamer used in this operation.

Tire size, trademark, etc., are then stamped on the mold by hand. The surface on which the stamping is to be located is first blued, and the correct lay-out made, so as to obtain the right spacing and location of the letters and numerals. Hold-down lugs, which are used to clamp the mold halves in the curing press, and a valve block for supporting the water bag connection when molding the tire are welded to the mold. Steel dowel pins are placed in the mold flange of the female half, and corresponding dowel-holes are produced in the flange of the male half. The correct doweling is important, not only to permit accurate radial location of the mold halves, but also to insure the correct line-up of the design on the inside cavities of the mold when they are brought together.

Radial vent slots, 0.062 inch square, also for the escape of air, are then sawed in the registry surface of the mold, as seen in Fig. 9. The saw is rotated by a standard air motor, mounted on a specially designed machine, which indexes the mold after each slot has been sawed. A similar set-up is employed to saw slots in the bead portion of the mold. These slots form raised beads on the tires, the function of which is to release any air trapped between the inner tube and the tire during installation and inflation of the tire.

On some types of tires a depressed bead is required. This is accomplished by inserting stainless-steel stampings in the saw slots and then finishing the inserts with a specially designed cutter to the dimensions that are specified on the drawings.

After the mold is completed, it is sent to the inspection department, where all dimensions, finishes, stamped numbers or letters, etc., are thoroughly checked against drawings and specifications. If any errors are found, the mold is returned to the mold department for corrections. If not, it is sent to the mold shipping department.

* * *

Roller Bearings Packed in Metal Cans

Anti-friction bearings shipped to the armed forces for materiel supplies are subjected to climatic and storage conditions much worse than those prevalent in industry. The bearings are often stored with little protection from the weather, and in many cases, they are exposed to salt water and other extremely corrosive materials. In addition, rough handling of packed bearings often prevails. As a result, present packaging methods are inadequate for all conditions.

The Timken Roller Bearing Co. is making an effort to solve the problem by packing the bearings in metal cans. Several packaging machines have been purchased, and a pilot line is being set up to determine the type of can and packaging method that will be most practical.

* * *

Unused Equipment Placed in "Moth Balls"

Industry has been advised today to put its unused valuable civilian producing equipment in "moth balls" until the present defense emergency is over. Such equipment can be protected against rust, according to the DeVilbiss Co., spray equipment manufacturer of Toledo, Ohio, by spraying a weather-tight, cocoon-like covering over it for the "duration." When the emergency is over, the cocoon can be easily ripped off.

HYDRAULIC FLUIDS in Industrial Equipment

The Application and Care of Various Fluids Are Important Considerations in the Servicing of Industrial Hydraulic Equipment. This Article Describes Hydraulic Fluids in Common Use and Some of their Outstanding Characteristics

By GEORGE N. DORR

ONE of the first considerations in assuring long dependable service of any industrial hydraulic system is the selection of the correct fluid. This choice depends upon a number of conditions, the most important of which are the kind of pump used in the circuit; the type of valves; the maximum and minimum atmospheric and operating temperatures; the anticipated work schedule; and the maximum operating pressure. Fluid of the proper quality is important enough to make its cost a secondary consideration, since the efficient operation of hydraulic equipment depends as much on the liquid that transmits the power as on the design and construction of the mechanical parts.

The Use of Water as a Hydraulic Fluid

In applications where large volumes of liquid are required, where freezing temperatures are not encountered, where the danger of fire is present, and where valves and pumps are made of rust-resistant materials, water is often employed as a hydraulic fluid. Such applications include plunger elevators, large forging presses, and bending machines. In these cases, a small amount of emulsifiable oil is added to the water for lubrication purposes and to reduce rusting and corrosion. Proportions of 2 to 10 per cent of the total volume of water in the system are added, the higher amount being of value in reducing the danger of freezing. Often, however, these mixtures become rancid, resulting in dirty solutions that may retard valve action. This, of course, necessitates cleaning the system and changing the solution periodically.

When water is used as the hydraulic fluid in presses, it is frequently necessary to grease the rams, as water is a poor lubricant. Of course, rubber packings should never be employed in these systems. Kerosene is sometimes used when hydraulic equipment is installed outdoors and freezing temperatures are encountered. When the danger of fire is not present and the cost of hydraulic fluids is an important factor, this liquid has been found to be suitable.

Generally, a well refined mineral oil is the best hydraulic fluid, particularly where the pressures developed are high, where pumps and valves are machined to close tolerances, and where production schedules allow little "down" time. This medium is widely used in the hydraulic systems of machine tools and of construction and transportation equipment, because oils lubricate, seal, protect against rust and corrosion, do not freeze, and will not boil or evaporate appreciably at high working temperatures.

Oils used for this purpose should be low in carbon and sulphur content and should contain no acids, since contamination of this sort causes sludge formations and destroys packings and metal parts. Moreover, the oil should have a low wax content, because free wax has a tendency to clog restricted orifices. Sometimes inhibitors or additives are included to improve the quality of the oil as a hydraulic fluid. This is not generally recommended, since the useful life of such additives is limited, and the contamination resulting from their failure more than offsets the advantages gained.

Essential Points to Consider in Selecting a Hydraulic Oil

In selecting a hydraulic oil for any particular purpose, several important characteristics must be taken into consideration. These include resistance to aeration, stability of viscosity, film strength, ability to maintain original properties for extended periods of use, and, of course, free-

dom from acids. The pour point must be at least 30 degrees below the lowest atmospheric temperature in which the equipment is to operate. If this condition is not met, wax may be thrown out of solution, with the results previously mentioned. An oil with the required pour point for a particular application is not necessarily satisfactory, since consideration must also be given to its viscosity.

Viscosity may be defined as the resistance to fluid flow of a substance. More accurately, it is that property of a fluid by which the fluid offers resistance to a shearing displacement. The selection and maintenance of the correct viscosity is essential in minimizing power losses caused by internal friction of the oil, and also in providing the proper seal between moving parts.

Inasmuch as pumps, valves, and controls for oil-pressure operation rely principally on close fits between mating members for creating and maintaining oil pressure, leakage through clearances results in increased temperatures and loss of capacity and power. These clearances obviously must be kept sealed; therefore the viscosity of an oil must be such that cold oil will flow freely while it seals, and it must continue to seal when it is hot and flows more freely.

It is desirable, then, that the viscosity of an oil remain as nearly constant as possible throughout its normal operating temperature range, since the smaller the change in the rate of flow with temperature changes, the greater the ability of the oil to seal under all operating temperatures. The ability of an oil to retain its fluidity with changes of temperature is measured by its viscosity index. The higher the viscosity index of an oil, the smaller the change of viscosity with change of temperature.

Leakage Losses are Inversely Proportional to Viscosity of an Oil

Leakage losses are inversely proportional to the viscosity of an oil; consequently, a heavy-bodied oil is generally used where these losses must be reduced and where it is also necessary to prevent excessive thinning out of the oil due to high temperatures, as in high-pressure systems. Highly viscous, or thick, oil flows so slowly, however, that valve actions are sluggish or a pump may have difficulty in handling it, with the result that excessive power is consumed and operating efficiency is reduced. Thin oils, on the other hand, flow so freely that they may fail to provide good seals, thereby lowering pump capacities and working pressures.

Since so many factors enter into determining the proper viscosity of an oil, it can only be said that, in general, heavy-bodied oils may be used in high-pressure systems, since the percentage of power loss is not as great as in systems of lower pressure. In low pressure systems, where leakage losses are usually smaller and power losses must be kept down, less viscous oils are used. Manufacturers' recommendations should be carefully considered for each individual case.

Another important factor to be considered in selecting a hydraulic oil is film strength. To prevent wear of moving parts, the oil must penetrate between closely fitting surfaces, so that they will be kept separated by a thin film of oil. This film must be maintained under the pressures, temperatures, and other conditions existing in the system.

The Problem of Oxidation

Continued agitation, suddenly varying pressure, and high temperatures cause oil to oxidize, or combine with oxygen. Unless the oil is capable of disassociating itself from the oxygen, sludge and gummy deposits, which may clog the circuit and interfere with its operation, are formed. Other causes of oxidation include water from the air or coolants, entrained air, and metallic particles.

Oxidation is accelerated by high temperature, which is often caused by the compression of confined air and its sudden release. Air may enter the system through faulty packings, defective pipe joints, the pump inlet line, or by having a low level of oil in the oil reservoir. The greater the pressure of this compressed air, the more pronounced is the increase in heat released. Some idea of the heat involved, when this occurs may be had when consideration is given the fact that air compressor cylinders must be cooled to carry away the heat they generate.

The amount of air that oil will absorb depends on the temperature and the air pressure developed. At 77 degrees F., and at atmospheric pressure, oil will absorb air in an amount equal to 10 per cent of its volume. At the same temperature, but at 200 pounds per square inch pressure, the amount of absorption is fourteen times as great. Generally, the temperature of a good grade of oil should not exceed 140 degrees F. At temperatures above this, the tendency toward oxidation increases rapidly.

A good hydraulic oil should be capable of quickly releasing entrapped air. When pressure in the system is reduced suddenly, confined air comes out of solution and causes foaming if the air bubbles are not quickly separated from the oil. Foam, or free air, causes chattering or irregular piston movement and interferes gener-

ally with smooth control and operation. If the air is released quickly, it can be vented out of the system. Foam can be brought to the surface of a reservoir, where it will do little harm, by placing a baffle in the tank between the point of discharge and the inlet to the pump. These baffles should extend above the oil level, but not all the way to the top of the tank.

It is practically impossible to prevent some moisture from entering a hydraulic system, and equally difficult to prevent the entry of some air. Water, for example, may enter the system through defective water coolers in the oil tank. When water or condensed air contacts metal parts, rusting occurs, although inhibitors may be used to retard this action. The mixture of water with oil—that is, emulsification—causes the formation of pasty sludges, which hamper the free operation of valves, pumps, and other close fitting moving parts. In addition, water emulsified with oil promotes aeration and foaming. The resistance of an oil to emulsion is an important property. A good hydraulic oil should permit water to settle out quickly in the reservoir instead of forming emulsions and circulating through the system.

Importance of Keeping Hydraulic System Clean

To provide dependable service, free from "down" time and other troubles, a hydraulic system must be kept as clean as possible. Every precaution should be taken to avoid contamination of the oil. Reserve oil should be stored in sealed drums, and the oil in use should be kept at the proper level in the tank. Working temperatures recommended by the manufacturer must be maintained. Where necessary, means should be provided for warming the oil if its temperature drops below 60 degrees F., and, conversely, it should be cooled if its temperature rises above 140 degrees F.

In filling a tank, the oil should be poured slowly through a funnel having a fine-mesh screen, which is thoroughly cleaned. As a general rule, the oil should be changed every thousand hours, since it is unwise to wait until trouble develops before replacing oil in a system. The use of an excessive amount of pipe sealing compound or gasket cements should be avoided. Another source of contamination to be guarded against is dirt that collects on the piston-rod or that passes through a breather or worn gaskets.

Sometimes a permanent magnet in the form of a pipe plug, installed in a quiet zone of the tank well below the oil level, will attract magnetic particles in the fluid. Air filters are often used when there is a lot of dirt in the air, and these, of course, must be kept clean. Oil filters are widely employed in hydraulic systems at the pump inlet or valve discharge points in the tank. They are of little use, however, unless they, too, are kept clean.

An important step in assuring efficiency in a new or contaminated system is thorough cleaning. In new installations, cleaning is advisable in order to remove any thread or gasket compound, white lead, or mill scale that may be present. To clean a system that has a great deal of sludge, steam may be used, although care must be taken to remove all traces of water afterward. Another method is to use a thin, warm solution having good lubricating qualities, such as kerosene. This may be pumped through the system for some time.

In using kerosene or chlorinated solvents, care must be taken to insure that none of the flushing fluid remains in the system, as, if the liquid is of low viscosity, it may thin the fresh oil and reduce its chemical stability. Moreover, flushing solutions of low viscosity are not always able to hold large solids in suspensions, and therefore are not effective flushing mediums.

Another means of removing contaminants is to dismantle the entire circuit and clean each individual part, using lint-free rags. Waste, for obvious reasons, should not be used. When thoroughly clean, the parts should be oiled and reassembled; the system may then be refilled and the circuit operated at an idling speed until all the pumps, lines, cylinders, etc., are properly charged. The oil level should then be checked, and oil added as needed.

* * *

New Standards for Metal Powder Industries

Two new standards for the metal powder producing and consuming industries have been announced. One of these specifies the preferred dimensions and tolerances of oil-impregnated metal powder bearings, or self-lubricating bearings. The other describes a method for determining the green strength of compacted metal powders. Copies can be obtained at 25 cents apiece by writing the Metal Powder Association, 420 Lexington Ave., New York 17, N. Y.

* * *

Last year, the United States produced about 48 per cent of the world's output of 198,700,000 tons of raw steel.

Why Taps Should be

IT was not too long ago that little consideration was given to the pitch diameter of taps. It has been even a fewer number of years since high-speed steel was used in taps, and a far shorter time since the practice of grinding the threads was introduced. But today with high-speed steels, improved methods of heat-treating, and ground threads, taps having very accurate and uniform pitch diameter are being regularly produced. Unfortunately, however, even such taps do not always cut accurately to size, largely because of errors in rake angle and inaccurate indexing of the cutting edges during the sharpening process.

Taps with concentric threads will generally cut closer to their own size than relieved thread taps, but it is common practice for tap manufacturers to make the larger size taps with relief in the thread. Generally speaking, threads are not relieved on taps smaller than 5/8 inch. Many people try to grind relieved-thread taps so that part of the thread is concentric, and the remainder relieved. However, the concentric section is not always the same on all taps, and this may be reflected in the accuracy of the size of the tapped hole.

In defining a tap whose cutting elements have been properly controlled for maximum efficiency, the term "precision sharpened" is used. This means that the chamfer is concentric with the threads, and that the chamfer relief is the same on all lands and of the correct amount. It also means that the cutting edges of the teeth are exactly spaced with relation to one another. If one cutting edge leads another, it will carry a heavier chip load, which will make the tap run out and tend to cut over size. On small taps, this condition is likely to cause breakage.

Finally, it means that the rake angle of the cutting teeth is the same on all flutes, and is the correct angle for the particular job for which the tool is to be used. This applies to the straight flutes of ordinary taps, as well as to the angle flutes of spiral-point taps. Problems of proper angles exist with taps, as well as with tools used on lathes, boring mills, milling machines, etc.

The devices employed for measuring rake angle vary according to individual preference. It would be helpful if a method of measuring rake angles could be developed that would be accepted as standard. The number of times a tap can be resharpened is a question. In one shop taps are reground an average of six times. Some taps have been reground as many as thirty-two times, but that many grinds is not considered practical. Some of the factors that reduce the average to six are accidental breakage of the tap; broken threads; and reduction in size due to back taper on thread form.

The number of holes per grind remains constant until the size of the tap is affected by the back taper. Reduction in the width of the land has a tendency to make the tap cut larger unless it is used with a lead-screw. Reduction in land width thus partially offsets the reduction in size mentioned previously. It is most important that the first threads be kept sharp, so as to cut to the proper size, because if wear takes place, a somewhat smaller size will result, provided the tap is sharp.

Some shops use unnecessarily precise taps. There is no economy in working to a Class 3 fit if a Class 1 fit only is required. There is no economy in using precision ground-thread taps if a commercial ground-thread tap will provide a satisfactory fit. A ground-thread tap might

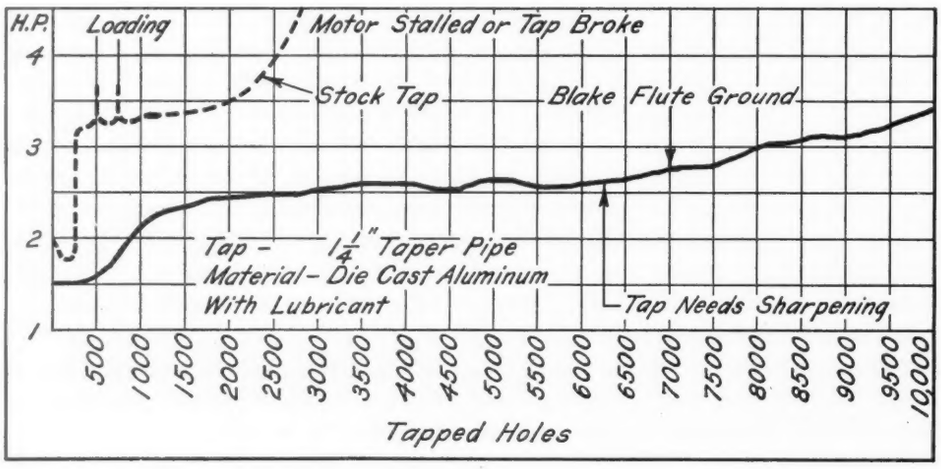


Fig. 1. Chart showing horsepower consumption of a stock tap used to tap holes in die-cast aluminum compared with that of a similar tap ground to correct the rake angle and flute spacing

Sharpened Precisely

By EDWARD BLAKE

provide advantages over a cut-thread tap because, in many instances, longer tap life would be obtained. A ground-thread tap also may be desirable when accuracy of lead is more important than class of fit. In the same way, it might prove more economical to use high-speed steel instead of carbon steel taps.

Keeping in mind the class of fit to be produced, the choice of the right tap for the job involves the following considerations:

1. The most efficient size of tap.
2. The correct design of tap for the work material.
3. The best cutting speed for the material.

In general, ground-thread taps, as obtained from the manufacturer, will cut 0.001 to 0.0015 inch over their actual size, and cut-thread taps may cut as much as 0.0025 inch over their size. Obviously, the largest size tap that can be made to cut within the class limits is the best size to choose, since it will wear longer before cutting a hole that may be slightly under size. Thus, before selecting the best size tap for a certain job, it becomes desirable to learn how much over its actual size a tap may be expected to cut.

Why is it that taps of apparently the same design and with the same pitch diameter and outside diameter and the same lead tolerance produce variations in hole sizes? In one shop, it was found that variations in the tapped hole sizes persisted even in tests run under laboratory conditions, and this led to a careful examination of the physical dimensions of the tap.

It was found that the tolerances in lead, pitch diameter, outside diameter, minor diameter, chamfer angle, and relief were generally well within close commercial tolerances, but the angle of hook in both the flute and the spiral point taps varied greatly, even on taps out of the same box. Specimen sections of literally hundreds of taps were taken and projected fifty times to measure the effective hook angle. Variation in rake angle, it is believed, causes the lack of uniformity in the tapped hole size. Since rake angles affect the tap action, it can be appreciated that, with different rake angles, taps that are otherwise identical will cut different sized threads.

If a tap has been cutting within the required limits and then begins to cut over size, chip loading is almost invariably the cause. This is another illustration of the importance of keeping the cutting face sharp, because chip loading is less likely to occur with a keen cutting edge.

When a tap cuts under size, grinding the cutting edge with more hook or rake will often increase the cutting size. Of course, merely sharpening the cutting edge will have a similar effect, but not to as great a degree, because a dull tap cuts closer to its own size than a sharp one.

In tapping long holes where the flute might become jammed with chips, over-size and irregular-size threads are produced because the lubrication is interfered with and excessive pressure may develop. The pressure is not uniformly distributed when some flutes accumulate more chips than others. If the threads are not accurately spaced, this is much more likely to happen.

When straight threads are being cut, most of the cutting is done at the top of the truncated thread on the chamfer, the sides doing little or no work. However, with taper-thread taps, like pipe taps, the top of the chamfered thread does some work, but both sides of every thread beyond the chamfer also do some cutting. It is

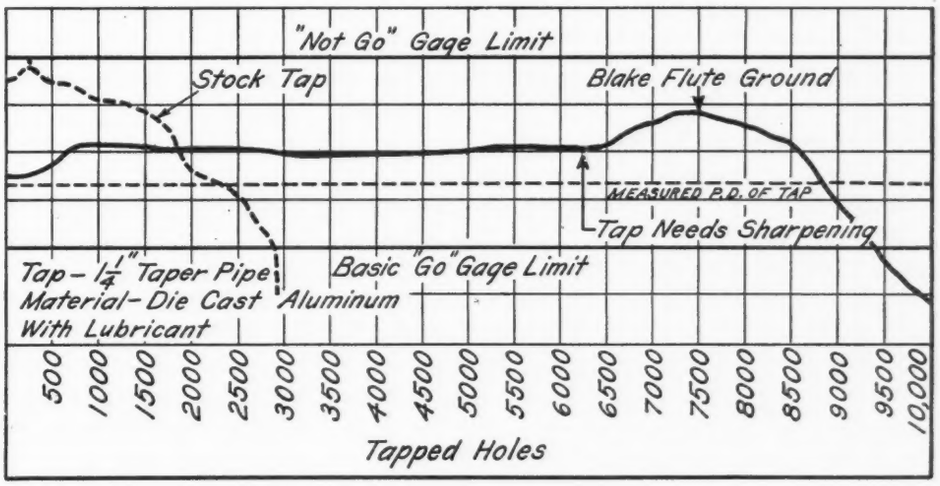


Fig. 2. This chart illustrates the comparative number of tapped holes that are produced within specified hole-size tolerances by the two taps used in making the tests charted in Fig. 1

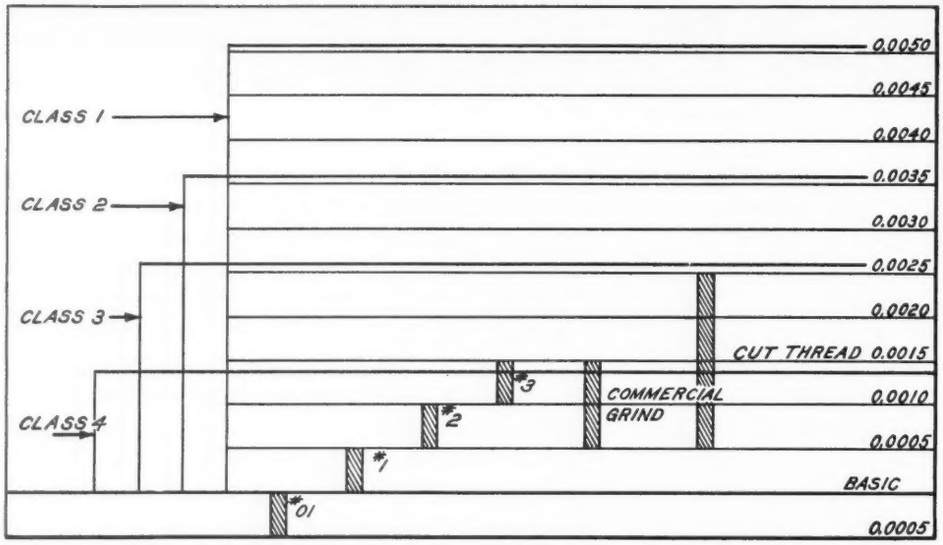


Fig. 3. Chart showing pitch diameter tolerances for cut-thread and ground-thread taps compared with gage limits for different classes of fits

important, therefore, that taper-thread taps be ground in the flute.

In cases where short through holes are being tapped, as in nuts, taps with long chamfers can be run faster than those with short chamfers, but in long holes, where the entire length of a chamfer might be cutting, a plug tap can generally be operated at a greater speed than a long taper tap. Bottoming taps, because of the very heavy cut on each of the first threads, should generally be run more slowly than plug taps, and, of course, tapping a full thread requires a slower speed than tapping a 75 per cent commercial thread.

High-speed ground-thread taps cost more than cut-thread taps, but the cost per hole is usually enough less to warrant the additional investment. It has been estimated that a ground-thread tap operated at high speed usually produces six times as many holes as a cut-thread tap. In addition, ground-thread taps produce finer work, cause less strain on the tapping machine, and, of course, will provide greater uniformity, with much longer tap life, because the lead is more accurate.

A ground-thread tap requires considerably less power to operate than a cut-thread tap. Also, all conditions being equal, the ground-thread tap needs only about one-fifth the number of sharpenings for the same number of tapped holes as a cut-thread tap.

In considering feeds and speeds for tap operation, the threads per inch on a tap must be taken into consideration. With taps, only the peripheral speed can be controlled, as they must advance in accordance with their lead, which is generally much faster than the feed of other metal-working tools. It has been found difficult to work out definite rules for the speed of taps due to the great variety of thread pitches that can be cut on the same hole diameter. As an example, a 1-inch tap with eight threads per inch advances three times as fast as a 1-inch tap with twenty-four threads per inch, and it must cut out nine times as much stock in one-third of the time if operated at the same speed.

There are those who believe that coolant has more to do with the accuracy of tapping than anything else, and it is admitted that the quantity and quality of lubricant can affect the results a great deal, but the accuracy of thread spacing and of rake angle are also of great importance.

It is not at all uncommon to see men carefully sharpening tap drills, and yet find that they never think of sharpening the tap for the same job, which may cost three times as much as the drill. Consideration should also be given the fact that very little more care is being given today to a $1.40 tap than used to be given to a similar tap that was bought for 6 1/3 cents. If that much more money has to be spent for a tap, it would seem advisable to spend an additional sum of money in taking care of the investment, so that the greater value that has been built into the tap is realized.

Fig. 1 illustrates the results obtained by precision grinding of taps. In this case, the work consisted of tapping die-cast aluminum, using a coolant. The tap was a 1 1/4-inch taper pipe tap. The machine was set up with a 3-H.P. motor directly connected to the spindle, and after the tap had been in use for a time, the motor would stall. The dotted line on the chart shows that when the tap was new it used about 2 H.P. As it became dull, the power consumption suddenly increased to about 3 1/4 H.P., ran along with a gradual increase, and then began to climb. Stalling took place at about 4 3/4 H.P.

Another tap from the same lot was first

ground in the flute, and then chamfer-ground and checked in the same manner. This tap, as shown by the solid line, used about 1 1/2 H.P. at the start, later climbed to 2 H.P., and then up to 2 1/2 H. P. It continued at that rate for some time. The size of the tapped hole was then checked, with the results shown in Fig. 2. The tap, as it came from the factory, first cut close to the top or "Not Go" limit, then cut a little over size and finally under size. The motor stalled after 2800 holes had been tapped.

The tap that had the spacing corrected and controlled rake angles on the edges started cutting close to the mean, cut a little large after the tap had run in, and then held steady for a considerable period. Later, as wear started to take place, the size of the tapped hole increased, and then gradually became smaller. However, the tap did not actually cut under size until after 9400 holes had been tapped.

If the tap had been resharpened after approximately 6000 holes had been tapped, there is every reason to believe that its performance could have been duplicated several times. If it had withstood an average of six sharpenings, as previously referred to, it would have machined 36,000 instead of 2800 holes. This would have meant nearly thirteen times as much production from a single tap.

The only extra cost would have been that of the sharpening. Furthermore, it would not have been necessary to buy the eleven additional taps required for the job in question. Every test, of course, will not work out in this same manner, but the foregoing is based on an accurately conducted test and may be considered indicative of possible results.

Regarding rake angle control, it is interesting to note the manufacturers' limits on the pitch diameter of taps compared with gage limits for different classes of fits, as given in Fig. 3. It can be seen that even the widest limits—those for the cut-thread tap—are within the range of Class 3. However, as previously stated, practically all taps will cut over their own size, the amount being dependent upon the design of the tap and whether it has a ground or a cut thread. It is obvious that the largest size tap that can be made to cut within the class limits is the best size to choose, as it will wear longer before cutting a tight hole.

The rake angle of the cutting teeth is of major importance. It varies from 14 degrees positive to 9 degrees negative in representative taps that are commercially available. However, tap manufacturers are beginning to recognize this as an important factor, and eventually all precision-ground taps will be supplied with accurately spaced cutting edges and controlled rake angles.

The way in which rake angle is controlled in a Blake tap grinding machine is shown in Fig. 4. As illustrated, the tap is set up in such a manner that the center line through the cutting edges is at 90 degrees to the grinding wheel. The dull cutting edge is then moved slightly ahead of center — say, 0.005 to 0.010 inch — which is enough to correct inaccuracies in the fluting. The wheel is dressed to a definite radius *R*, and the center line of the wheel is offset from the center line of the tap a certain amount *A*. When the

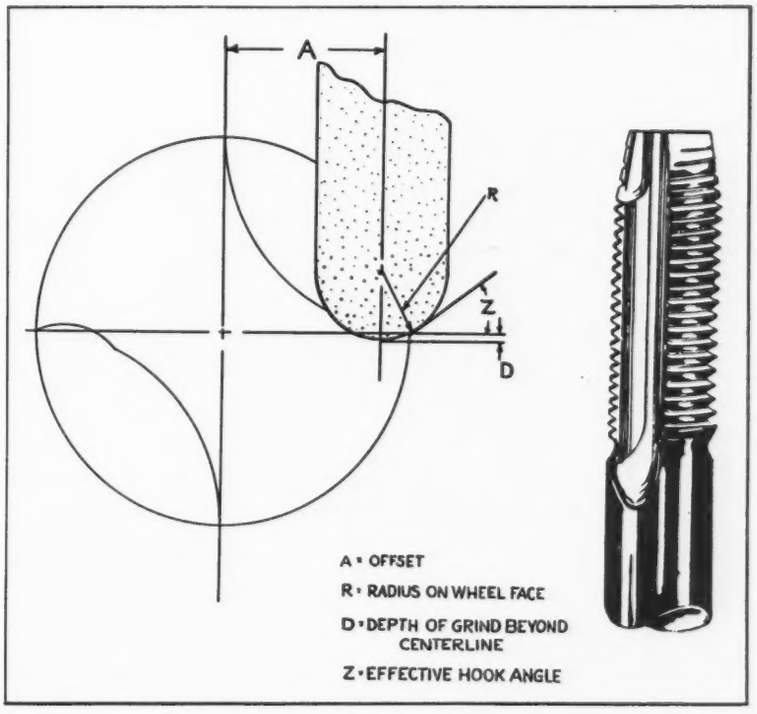


Fig. 4. Diagram illustrating the manner in which rake angle is controlled in grinding taps in a Blake flute grinder

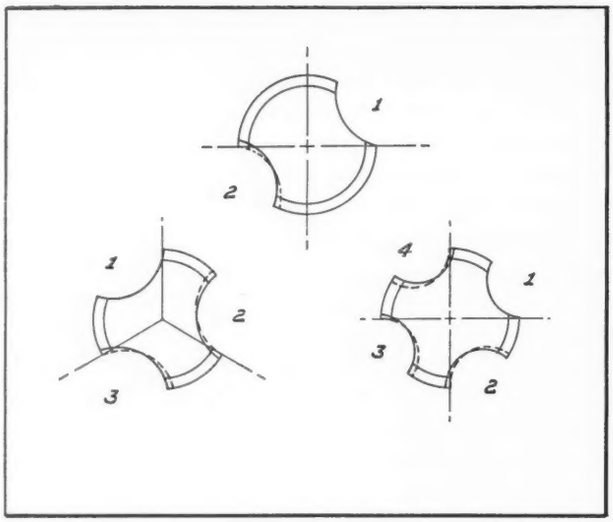


Fig. 5. An error of 1 degree in indexing taps while grinding the flutes results in cumulative errors. The effect in the case of two-, three-, and four-fluted taps is illustrated here

grinding wheel has been fed to depth D, the hook angle Z is obtained. By closely controlling A, R, and D within reasonable tolerances, the hook angle produced will be very accurate.

The tap is then indexed by means of an index-plate mounted on the spindle, thus insuring that the cutting edges are evenly spaced. The amount of error that exists in the spacing of the cutting edges on ordinary taps is surprising. In small taps this causes breakage, and in all taps it causes the tap to cut larger.

The best rake angle for a given job cannot be specified definitely because there are too many factors involved over which there is no control. However, figures are available that can be used as a guide in determining the correct angle.

In a four-flute tap, the cutting edges should be exactly 90 degrees apart. Fig. 5 shows what happens with two-, three-, and four-flute taps if there is an error of 1 degree in indexing. In the case of the two-flute tap, one edge, instead of being 180 degrees from the other, is only 179 degrees in one direction and 181 degrees in the other. Referring to the sketch of the three-flute tap, it can be seen that the No. 2 cutting edge is 1 degree advanced and the No. 3 tooth is 2 degrees advanced of where it should be. In the four-flute tap, the variation is very noticeable because there is an accumulation of 1 degree in each flute, so that the fourth cutting edge is 3 degrees ahead of the first cutting edge.

It has been found that the double radius effect acts the same as a chip-breaker on a turning tool. This is of definite assistance in chip clearance, and generally minimizes loading at the heel of the tap. The radius can be blended into original flute if desired.

Surface finish on high-speed steel taps is of considerable importance when operating on some materials. An extremely good finish is obtained when a coolant is used in grinding taps. Even when the tap is to be nitrided or chrome-plated, the finish provides a good base.

The best way to hold taps for chamfer grinding is between centers, but this is not always possible. The Blake tap chamfer grinder shown in Fig. 6 is arranged to hold taps between centers —by the shank—or on the top of the thread in individual bushings of the correct size. The machine illustrated is equipped with a universal collet chuck work-spindle which permits holding taps having shank diameters up to 1 1/2 inches.

It is basically wrong to grip the tap by the shank and attempt to grind the flute without

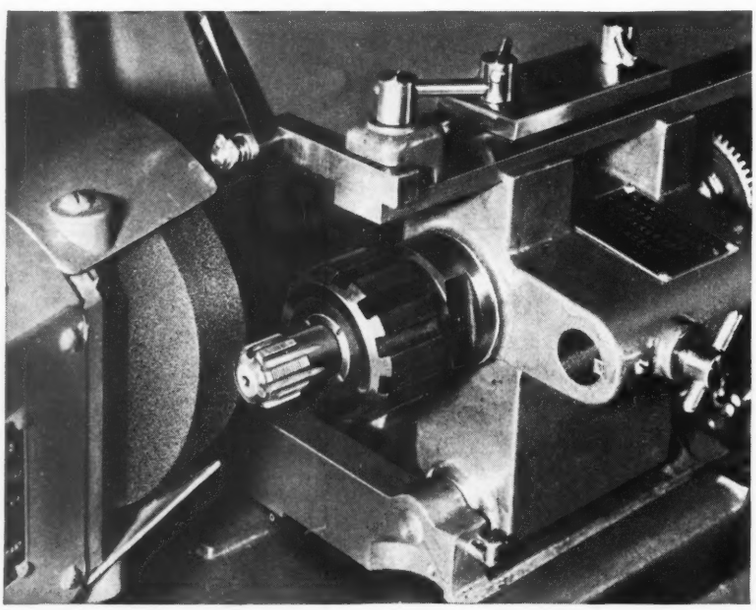
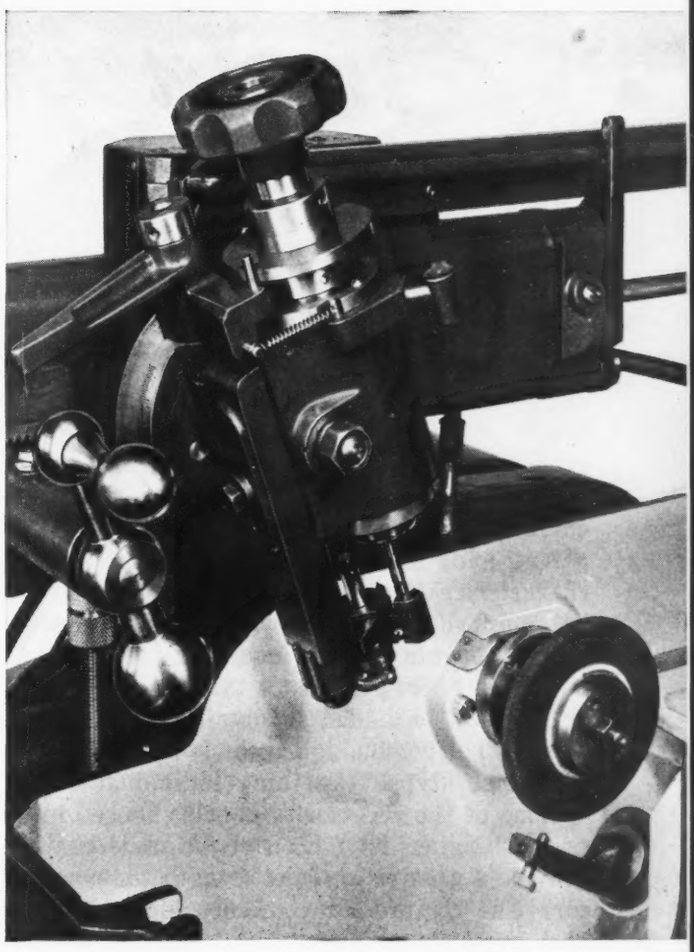


Fig. 6. The Blake tap chamfer grinder holds taps with shank diameters up to 1 1/2 inches in a universal collet chuck work-spindle

Fig. 7. To eliminate vibration, taps are supported at the end for grinding the flutes



having the front end supported to prevent vibration. The smaller the tap, the more vibration there will be, and this causes breakage of the tap and loss of accuracy.

Flute grinding operations should meet the following requirements:

1. Section of tap to be ground must be firmly supported to eliminate vibration.
2. Accurate adjustments of machine must permit of grinding flutes in equal amounts.
3. A wheel-dressing attachment should be provided on the machine to insure maintaining the correct contour of the flute.
4. Adjustments must provide for duplicating grinds found to give best results.
5. Grinding must be done with a coolant.

Fig. 7 shows the method used in the Blake flute grinder for supporting the tap at the end to eliminate the vibration factor. The tap is gripped on the shank in a collet that has a very narrow land and thus gives a floating effect. It rests firmly against a half bushing close to the front end. The support given by the half bushing directly opposes the pressure of the grinding wheel, and flutes are ground concentric with the outside diameter, regardless of any possible shank run-out.

Apprentice Training Course for Tool and Die Makers

In response to the demand by labor and management for a course of study to be used in training apprentice tool and die makers, the California State Department of Education has prepared a set of instructional materials for this purpose. The course consists of two books, a work book containing six major units covering over fifty technical subjects, and a test book containing tests for each of these subjects.

The material covers tools, jigs, and fixtures; gages; punch press dies; forging dies; die-casting dies; and plastic dies. Each of the sections was prepared by an expert. In planning the course, it was assumed that the student has completed the machinist apprentice training course books previously published, and for that reason machining processes are not included in the new books.

Those interested in this course can obtain information as to prices and further details by writing to California State Department of Education, Bureau of Text-Books and Publications, Library-Courts Bldg., Sacramento 14, Calif.

Carboloy Coordinated Tool Control Plan for Increasing Production Efficiency

In view of the current interest in methods and practices that will raise output per machine-hour and man-hour, the Carboloy Department of the General Electric Co. has issued a new plan book showing how its "CCC" plan for coordinated tool control can be effectively used for increasing production and productive efficiency.

The objectives of the plan are to insure obtaining (a) maximum production per machine; (b) maximum machine speeds; (c) maximum adherence to tolerances; (d) maximum tool life and minimum "down" time; (e) maximum pieces per tool; and (f) minimum number of rejections. The plan has been revised to meet present conditions by placing increased emphasis on factors that will help meet labor stortages and on the standardization of readily available tool styles and sizes, the conservation of scarce carbides, and the reduction of rejections, together with increased output. Copies of the book are available to management personnel by writing to Carboloy Department of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.

Engineering News

New G-E Turbo-jet Engine for Military Aircraft

The latest turbo-jet engine developed by the General Electric Co., designated J-47-GE-21, is shown in the accompanying illustration. Although it is the same size as the company's present J-47, which is used in such planes as the North American F-86 "Sabre" fighter and the six-jet Boeing B-47 "Stratojet" bomber, and is rated in excess of 5200 pounds thrust, the new engine is considerly more powerful.

Anti-icing features and high-altitude starting characterize this "all weather" engine. It can be equipped for either water-alcohol injection or after-burning to provide greatly added thrust power for short periods. A tail-pipe variable jet nozzle may be added to obtain maximum efficiency. The combustion space is of the so-called "cannular" type, containing individual "cans."

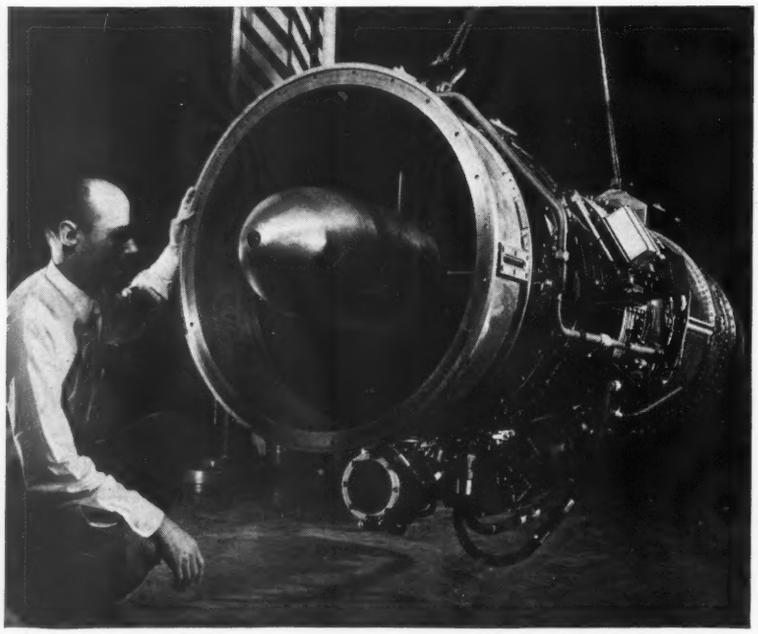
Some of the accessories usually housed in the nose of engines have been placed underneath to provide a greater air-inlet area to the compressor. The compressor combines high air flows, high pressure ratios, and high efficiency with a minimum number of stages. The basic engine control is a hydraulic system, and the exhaust temperatures are controlled electrically. The oil is cooled by engine fuel and is contained in a tank on the engine.

"Hot noses," achieved by bleeding hot air from the compressor to hollow nose parts, and retractable air inlet screens are used to prevent the collection of ice on the critical inlet parts. The engine was developed in record time—eighteen months from the time drawings were under way fifty-hour tests had been completed.

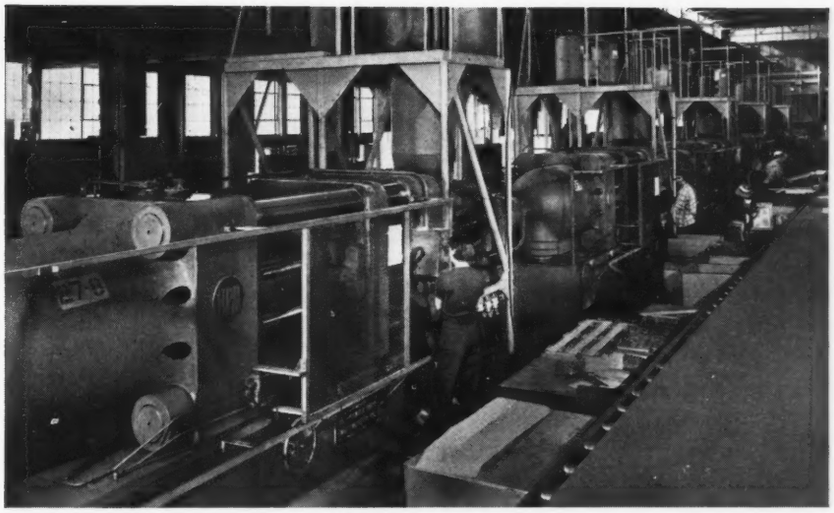
Contour Mapping of Optical Surfaces with Light Waves

Contour maps of precise optical surfaces, whose contour intervals are a small fraction of a wave length of light, have been prepared by the Optical Instruments Laboratory of the National Bureau of Standards. These optical maps reveal ridges and depressions measured in millionths of an inch. The basic procedure of photographing the interference patterns that are formed when light waves are reflected from the surfaces of the specimen and a standard reference of known shape has been modified appreciably. In the method worked out by the Bureau, additional lines are placed between each of the half-wave length lines, thus reducing the spacing between the lines (contour interval) to one-thirtieth wave length, or six ten-millionths inch.

One example of the application of the new maps is in checking the accuracy of the surfaces of optical flats, which are quartz plates for calibrating the precision gages used by science and industry that must be flat to five-millionths inch.



Latest turbo-jet engine developed by the General Electric Co. for military aircraft. Anti-icing features and high-altitude starting characterize this powerful "all-weather" engine



Five injection molding machines, each weighing more than 100,000 pounds, which are capable of molding 60 ounces of plastic per cycle

Mass Production Line for Molding Large Plastic Parts

What is believed to be the world's biggest production line for large injection molded plastic parts was recently placed in operation at the new factory of the General American Transportation Co., East Chicago, Ind. Typical parts being molded are household refrigerator freezer-chest doors and humidifier drawers, and television windows. For such production, giant injection molding machines, weighing over 100,000 pounds each, are required. Molds are "squeezed" with 1000 tons pressure. The force required to "squirt" the hot plastic into the chilled mold is 20,000 pounds per square inch.

Five of these machines, each capable of molding 60 ounces of plastic material per cycle, are shown at work in the illustration. These huge machines were designed and built by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, and incorporate features which permit a production cycle of normally less than one minute. Parts molded on the machines are placed on a conveyor belt, seen at the lower right, which transports them to the packing department at the other end of the plant.

Microfilms Preserve Engineering Drawings at Ford Plant

Tiny sheets of 70-millimeter microfilm—about 4,250,000 of them—will provide the Ford Motor Co.'s huge River Rouge plant in Dearborn, Mich., with maximum security for its records in the event of a bombing attack. Microfilms of each of its important drawings of dies, gages, jigs, and fixtures are being made, and all old and current engineering drawings of its cars, trucks, and engines are being microfilmed.

Negative copies of microfilms made so far have been placed in fireproof storage vaults in Dearborn, while the positive copies are stored in bombproof underground vaults. The extent of the operation is shown by the fact that Ford's engineering staff alone, during 1949, used 13,000,000 square feet of blueprint paper, 7,000,000 square feet of diazo paper, and 500,000 square feet of autopositive paper.

At first 35-millimeter microfilm was tried, but it was found to be impractical to locate a specific drawing on film reels. Individual frames, cut from the reel, were too small, and separate mountings for them required a relatively large labor outlay. With the assistance of the Precision Microfilm Corporation of Detroit, Ford began using 70-millimeter film, which gives a negative 2.625 by 3.5 inches in size. Individual negatives will reproduce blueprints up to 37 by 50 inches, while larger prints are covered in sections. Each 70-millimeter negative, cut from the roll, is placed in a 3- by 5-inch envelope that carries pertinent information about the print, and is then filed according to blueprint number. It was found that 1,000,000 tracings could be placed in eleven fireproof storage safes, at a saving in office space of $21,000 yearly.

Another feature of the 70-millimeter microfilm is that it is large enough to permit much of the information to be read without the aid of a viewer. From the original microfilm negative, an enlarged intermediate print is made on transparent paper or linen. This enlargement is processed by blueprinting or dry process machines in whatever quantities are desired. This permits the original tracing to be kept for design changes, and is saving more than $75,000 annually in retracing costs.

As changes are made in the original drawings, additional negatives are placed in the same envelope with the original microfilm.

Higher Machine Tool Prices Permitted To Stimulate Production

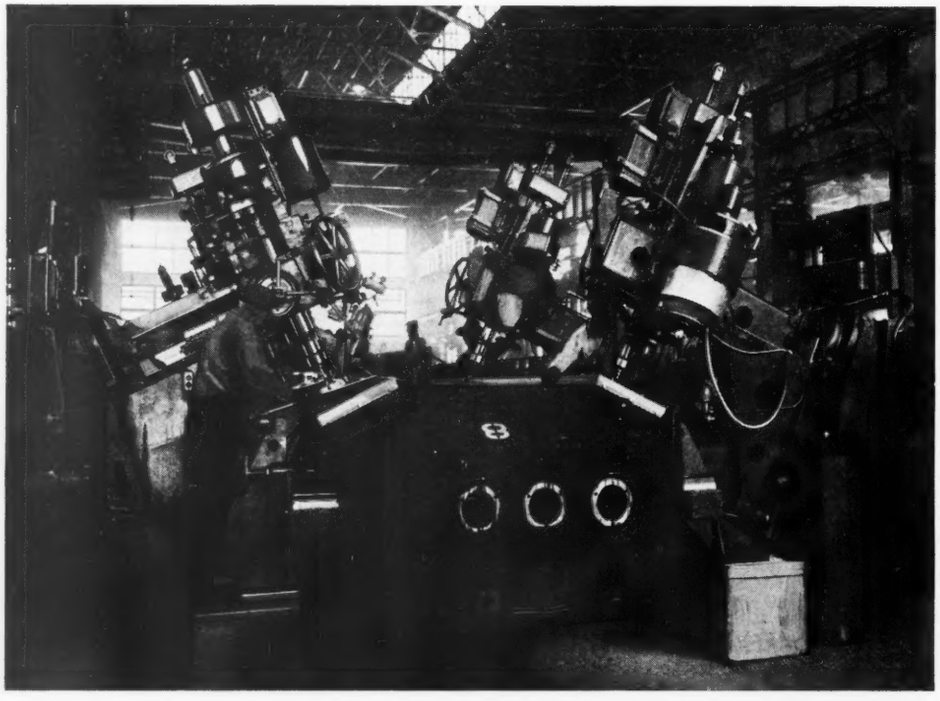
THE Office of Price Stabilization, on July 12, loosened price controls on machine tools, in order to promote a huge defense expansion of machine tool production. It was announced that the defense program aims at an annual machine tool production rate of $1,000,000,000 by the end of 1951, compared with $675,000,000 at the mid year and $432,000,000 last March. The Munitions Board hopes that $2,900,000,000 worth of metal-working machines will have been built by July 1, 1952.

The new OPS order (GOR 15) went into effect on July 16. It was issued pursuant to a directive from the Office of Defense Mobilization, and applies to all machine tool manufacturers, whether or not they are pricing under Selling Price Regulation 30, which would have applied to them if they had completed their filing by June 15 and waited the required fifteen days. Otherwise, the effective date of CPR 30, originally July 2, has been indefinitely postponed pending congressional action on price control legislation.

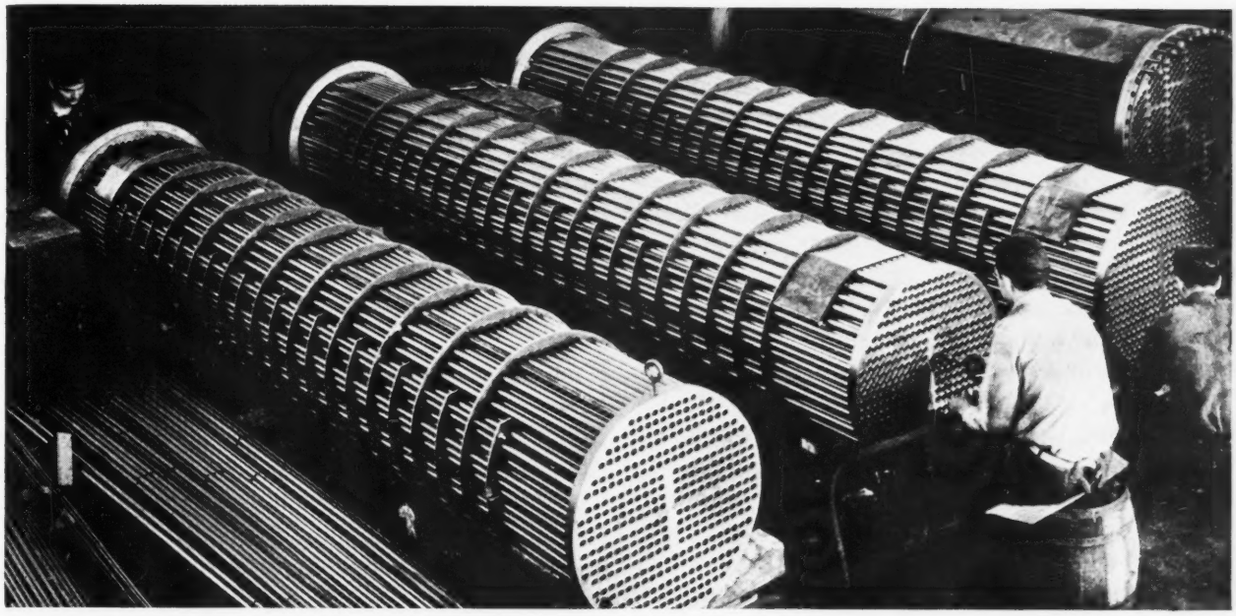
Regulation GOR 15 goes beyond previous regulations in providing adjustments on an over-all basis or for a particular machine tool. Under this order, a machine tool manufacturer may secure an over-all adjustment that will enable him to realize 80 per cent of his average rate of return during the years 1938 through 1948. Apparently, for a particular machine tool or machine tool attachment a manufacturer may secure an adjustment that will permit him to establish a price that will give him 80 per cent of his rate of return plus 5 per cent. The standard for determining adjustments on an over-all basis is the same as that used by the Bureau of Internal Revenue for determining excess profits taxes in the machine tool industry.

Machine tool manufacturers are required to file reports with the OPS Industrial Materials and Manufactured Goods Division before selling at increased prices permitted by the regulation. Within sixty days after a year has elapsed, they must show actual rates of return computed with previous calculations, or in the case of particular adjustments, actual average total unit costs.

Manufacturers may apply for adjustment of their ceiling prices whenever they can demonstrate an actual or threatened reduction in their rate of return.



Hulls for the redesigned N-47 General Patton tanks are being rebuilt from World War II models at the Eddystone plant of the Baldwin-Lima-Hamilton Corporation. Slope sheets on the tank hull are drilled for suspension-bracket bolt-holes by means of the large multiple-head drilling machine shown. The hull is positioned for all machining operations by four fixed reference points, dowel-pins entering openings for the idler sprocket axle and final drive housing



Forming and Fabricating Seamless Nickel Tubing

Methods Recommended by the International Nickel Co. for Coiling, Bending, Threading, Expanding, Welding, and Brazing Nickel and High-Nickel Alloy Seamless Tubing — First of Two Articles

NICKEL and high-nickel alloy seamless and welded tubing are used extensively in chemical and food-processing industries in the form of pipe lines, condenser and evaporator tubing, and coils for heating and cooling. Tubing made of these materials responds readily to the forming and fabricating operations of coiling, bending, threading, expanding, welding, and silver brazing, provided due consideration is given to the temper and the points of difference in its behavior from that of other tubing materials.

Information contained in this article refers specifically to seamless tubing that has been processed under controlled conditions. Welded tubing, welded and drawn tubing, brazed tubing, hot-rolled seamless tubing, and large-size, cold-drawn seamless tubing are not included, since their properties depend upon the methods of manufacture employed.

Modern practices used for expanding tubes into supporting plates or tubesheets are adaptable to nickel, Monel, and Inconel tubes. The tubesheet holes are drilled, or drilled and reamed, and, if specified, locking grooves are machined in the holes. For expanding the tubes into the tubesheet holes, the over-size allowance on the tubesheet holes relative to the nominal outside diameter of the tubes should be held to a minimum. The approximate over-size allowance on the tubesheet holes is 0.005 to 0.008 inch greater than the nominal outside diameter of the tubes up to 1 1/2 inches diameter, and 0.008 to 0.010 inch for tubes of larger diameter.

Tubes 5/8 inch in diameter and larger are expanded with self-feeding, three-roll type expanders. Tubes from 5/8 to 1 inch in diameter can be expanded by drifting with sectional expanders, and tubes smaller than 5/8 inch are usually drifted. The tube ends are flared in the conventional manner when specified. Tubes to be rolled in or drifted into tubesheets should have their ends reamed and beveled. Controlled rolling equipment should be used for expanding tubes into tubesheets to prevent over-expanding of the tubes.

Although not mandatory, it has been found best practice to have the tubesheet of a somewhat higher hardness than the tubes that are to be expanded. This is most important when the thickness of the tubesheet is not greater than the outside diameter of the tubes, or when the center to center spacing of the tubes (tube pitch) is less than 1 1/4 times the outside diameter of the tube or less than the outside diameter of the tube plus 1/4 inch, whichever is greater.

Plates for use as tubesheets in condensers, evaporators, and heat exchangers are designated "hot-rolled," "as-rolled," or "press-flattened." Solid nickel, Monel, and Inconel hot-finished (forged) rings are available up to 28 inches in diameter for this purpose. Generally, a forged plate will have a higher hardness than "hot-rolled," "as-rolled," or "press-flattened" plate. However, there can be no assurance that this will be so in every instance, because of certain production factors beyond commercial control.

Cold-drawn nickel, low-carbon nickel, and Monel tubing suitable for expanding into tubesheets is available in the following three conditions—annealed, stress-relieved, and stress-relieved with annealed ends. Inconel tubing is supplied only in the annealed condition for expanding into tubesheets of heat exchangers.

From the standpoint of heat-exchanger design, it is difficult to state whether stress-relieved or annealed tubing should be specified when such material is to be expanded into nickel, Monel, or Inconel tubesheets, steel tubesheets clad with those materials, or solid steel tubesheets, in view of the fact that both tempers have been used satisfactorily.

The stress-relieved temper may be slightly harder than the tubesheet material. Although this condition is generally not desirable for reasons previously stated, it does not preclude the use of such temper materials. Expanding or rolling of tubes is affected by such design factors as thickness of tubesheet, wall thickness of tubing, tube spacing, clearance between the outside diameter of the tube and the hole, and relative temper of tube and tubesheet, as well as by rolling practice.

The designer should exercise caution in specifying stress-relieved temper in preference to annealed temper unless the fabricator knows from past experience that he can satisfactorily roll or expand the stress-relieved material. Where such experience is lacking, it is suggested that trial tests be run on both stress-relieved and annealed tube material, using the same design and rolling practice as will be employed for the contemplated installation.

Stress-relieved temper should be considered for such applications as high-pressure installations where relatively high velocities are a factor and better resistance to erosion (due to higher hardness) is desired; cases where resistance to erosion and better heat transfer (due to use of thinner wall thickness) is of greater importance than ease of rolling; and packed tubes.

Annealed tubing is used where optimum rolling or expanding characteristics are desired, and also for all cold-bending (with or without a mandrel). Provision should be made for properly supporting long lengths. Annealed tubing is preferred for silver brazing and welding. Stress-relieved tubing is also suitable for silver brazing and welding, but the superficial oxide present must be removed mechanically from the surface of the tubing in the area of the joint.

The special duplex temper, stress-relieved with annealed ends, is often considered where higher resistance to erosion or greater rigidity (long tubular lengths) than can be obtained with annealed tubing is desired, and where design and rolling practice make it necessary for the tube ends to be softer, in order to provide greater ease in expanding.

Flanging to Form Van Stone or Rolled Joints

Light-wall tubing, up to 12 Stubs gage (0.109 inch), can be flanged from annealed material to form Van Stone or rolled joints. Flanging of heavier walled tubing is normally done hot, using either cold-drawn or annealed material. The ends of tubes that are to be "Van Stoned" should be reamed and beveled to prevent splitting as the tube is flanged. The diameter of the cold "Van Stoned" flange should not appreciably exceed 30 per cent of the nominal tube diameter. In connection with Van Stone fabrication, instructions subsequently given under "Hot-Bending" regarding cleanliness and best hot-bending temperature ranges should be adhered to.

Threading of Nickel Tubing

Pipe-fitters who have had little or no experience in the hand-threading of Monel and nickel pipe might have a little difficulty on the first trial in making tight joints. Leaks result usually from the use of dies that have been blunted and dulled from threading steel pipe. Monel, nickel, and Inconel are strong, tough materials that can be cut most satisfactorily with tools having sharp cutting angles. Pipe dies especially ground for threading Monel and nickel, and a cutting oil of the right viscosity to cling to the

work during hand-threading, are both available from the Armstrong Mfg. Co., Bridgeport, Conn.

To turn out a good pipe-fitting job with the high-nickel materials, the equipment must be in good shape. The dies must be sharp; the back rake from the cutting edge should be greater than is required for steel or iron pipe; and the dies should fit the die bodies or stocks properly. The ends of the pipe should be cut square, and should be free from burrs.

The thread should be cut the same length as the width of the die. When the thread is fully cut, the pipe should be flush with the outer face of the die. It is good practice to "butter" the threads with a good anti-seizing compound such as white lead paste and tallow (fifty-fifty) before joining. Lead compounds should not be used on pipe that will be seal welded or subjected to high temperatures (600 degrees F. or higher).

Pipe threads produced with tapered thread chasers mounted in non-receding holders for internal threading, or in non-expanding holders for external threading, invariably leave longitudinal impressions on the threads. Frequently these impressions are the cause of leaking threads. These marks on the threads can be avoided by using a receding chaser holder for producing internal threads and an expanding type chaser holder for producing external threads.

Bending and Coiling of Tubing

Cold-bending may be done in three ways:

1. With mechanical bending equipment using no inside mandrel or filler material.

2. With mechanical bending equipment and the use of an inside mandrel.

3. With mechanical bending equipment using an easily deformed filler material, such as "Tuballoy," made by the Parker Appliance Co., or "Cerrobend" and "Cerrobase," made by Cerro de Pasco Copper Corporation.

Cold-drawn, annealed tubing is recommended for all cold-bending operations. Cold-drawn, "as drawn," or stress-equalized tubing is suitable for hot-bending operations. Revolving-die and stationary-die bending machines employing a stationary wiper block and a sliding guide block (where the tube is drawn away from the mandrel) have been found most satisfactory for bending both with, and without a mandrel, as machines of this type permit uniform distribution of stresses in the tube during bending.

In order to support the walls of the tube and avoid wrinkling, dies used for bending annealed tubing unfilled and without a mandrel should be somewhat smaller than those used for bending with a mandrel or filler. This process of bending is suitable only for tubing, the wall thickness of which is not less than one-fifteenth, or about 7 per cent, of the outside diameter of the tubing. Tubing within this ratio of outside diameter to wall thickness can be bent satisfactorily to a mean radius of three or more times the outside diameter of the tube. This rule is applicable to all tubing of Stub's gage wall thickness and to iron pipe sizes up to and including 2 1/2 inches.

Light-gage tubing may be bent to short radii with freedom from wrinkles. The reduction of wall thickness on the outside of the bend is very slight. Practical experience has shown that with proper mechanical bending equipment, annealed nickel, Monel, and Inconel tubing can be bent cold, using a mandrel, to a mean radius of two

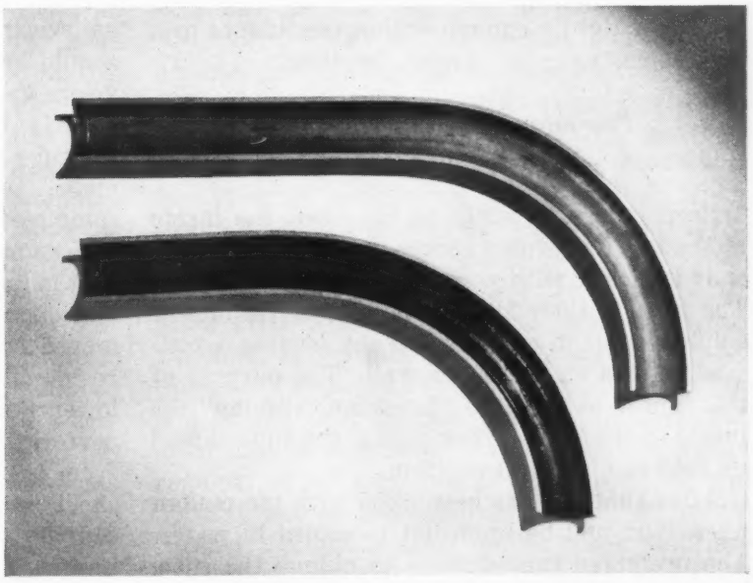


Fig. 1. Inside view of two Monel tubes that have been bent through 90 degrees. Deposit left by rosin filler can be seen in lower tube. The upper tube, bent with a low melting-point alloy, has a clean inner surface

diameters or greater, provided the wall thickness is not less than 5 per cent of the outer diameter of the tubing. For example, tubing having an outside diameter of 1 inch and a wall thickness of 0.050 inch can be bent to a mean radius of 2 inches. This general rule applies to all tubing up to and including 2 1/2 inches iron pipe.

Cold-Bending with the Aid of Fillers

The general rule for cold-bending annealed tubing up to 2 1/2 inches in diameter with the aid of a filler material may be expressed as follows: Tubing can be bent to a mean radius of 1 1/2 to 2 times the outside diameter, or greater, provided the wall thickness is not less than 5 per cent of the outside diameter. The minimum mean radius of bend for tubing larger than 2 1/2 inches outside diameter, having a wall thickness not less than 5 per cent of its outside diameter, should be about four or five times the diameter of the tube.

The preferred filler materials for cold-bending nickel and high-nickel alloys are the low melting-point alloys, such as "Tuballoy," "Cerrobend," Woods Metal and "Cerrobase." "Tuballoy" and "Cerrobend" melt at about 160 degrees F., while "Cerrobase" melts at approximately 250 degrees F.

The manufacturer recommends "Cerrobend" for tubes up to 1 3/4 inches in diameter and "Cerrobase" for larger tubing. These alloys shrink slightly upon solidification, but the shrinkage is offset by dimensional growth at room temperature, which tends to assure the elimination of voids occuring within the filled tube.

Sand is not a satisfactory filler material for cold-bending because it is practically impossible to pack it tightly enough within the tube to prevent some "cave in" during bending.

Procedure in Applying Low Melting-Point Fillers

Preparatory to applying the filler, the inside of the tube is cleaned thoroughly and one of the ends is closed with a wooden or a rubber plug. The tube is then filled with a light oil of low sulphur content, and drained out, leaving a residual oil film on the inside wall. The purpose of this film is to keep the filler from "tinning" the inside of the tube. When filling, the tube should be held in a vertical position.

After the tube has been filled with the molten filler, it should be immediately cooled in water. The preferred procedure is to plunge the tube, held in an upright position, into a circulating water tank and leave it there until it is completely cooled. Should there be no quenching facilities, the filled tube should be flushed or hosed with cold water, starting from the bottom and working upward. Rapid cooling, as just described, is essential with these low melting-point alloys in order to obtain a cast structure in the filler alloy that will possess cold ductility suitable for bending.

Prior to bending, the filled tube is warmed to about 100 degrees F. and then bent with slow, uniform pressure over a forming block or in a conventional bending machine. After bending, the filler alloy is melted and run out of the tube by heating it in boiling water. A torch should not be used for melting the solidified filler material. "Cerrobase" can be melted by heating the tube in a hot oil bath, held at about 325 degrees F. It is desirable to use a low-sulphur oil and to thoroughly remove the oil from the surfaces of the tube. If an oil of questionable sulphur content is used, it is important that every trace be removed.

Upon complete removal of the filler, the tubing is flushed out with a solvent to eliminate all traces of the oil with which it was filled initially. Then it is cleaned with a hot (180 to 200 degrees F.) 10 to 20 per cent solution of trisodium phosphate or sodium carbonate, and thoroughly rinsed in water to remove any film of the solvent that might have remained. All cleaning operations are followed by several water rinses.

Other filler materials that may be used in cold-bending, are molten rosin and lead. Before applying the filler to the tube, a wooden plug is driven into one end. When lead is used, the tubes are first filled with an oil after which the oil is drained out as previously described. In this case also, tubes should be held as nearly vertical as possible when filling, and additional filler should be added to feed the shrinkage that develops upon solidification. Then a second wooden plug is driven tightly in against the filler, and the tube allowed to cool fully before the bend is made. After the bending operation has been completed, the filler can be melted with torches and emptied out.

It is imperative that all traces of rosin or lead and oil used in conjuction with the lead be removed from the inside of the tube. Residue of rosin will be left in the tubes, as seen in the lower view of Fig. 1, unless adequate cleaning is performed. Rosin may be thoroughly removed from the inside of the tubing by soaking for a short period in 25 per cent concentration boiling caustic soda. As rosin presents a serious fire hazard if it becomes too hot, the heating must be

kept under control, and watched carefully after the rosin is completely melted to prevent the temperature rising to its boiling or flash point.

Press Bending and Roll Bending

Presses equipped with wing dies are preferred for bending nickel and high-nickel alloys. Press bends can be made through an included angle of 120 degrees. Heavy walled tubing, such as in iron pipe sizes and heavier, is suitable for press bending to a mean radius of six times the tube diameter, or greater, without support being given to the inside diameter of the tube. Tubes having a wall thickness not less than 5 per cent of the outside diameter, supported with a filler material, can be bent to a mean radius of three times the diameter of the tube, or more, without the formation of wrinkles.

The limitations for bending with three-roll benders follow, in general, those cited for press bending. However, when 360-degree bends are to be made, the minimum mean radius of bend ought to be held to four times the diameter of the tube.

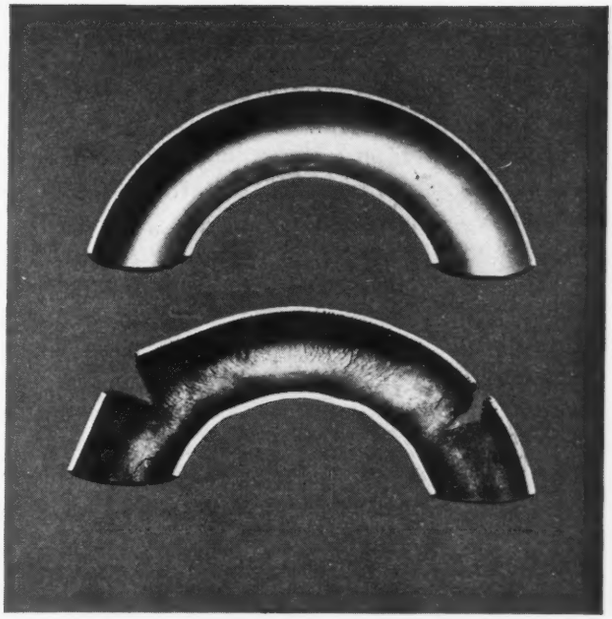


Fig. 2. Sectioned nickel tubes that have been hot-bent. Lower specimen is an example showing the effects of using sulphur-contaminated filler sand. The good tube seen in upper view was hot-formed with sulphur-free filler sand

Hot-Bending Restricted to Larger Tubes

Hot-bending of thin-walled tubing should be avoided if possible, because the thin walls do not retain heat sufficiently long to give good results. Hot-bending should be confined to sand-filled tubing of 2-inch iron pipe size and larger. Hot bends to mean radii as short as twice the diameter of the tube can be made on sand-filled tubes of 2- and 2 1/2-inch iron pipe sizes. On larger diameter pipe, it is necessary to increase the radius of the bend.

When hot bends must be made, cold-drawn "as drawn" tubing should be used so as to avoid excessive grain growth in heating. Cleanliness of tubes that are to be hot-bent is essential. All oil, grease, paint, chalk, and other foreign material should be removed from both inner and outer surfaces with a suitable solvent. Any residue of the cleaning solvent should be eliminated by dipping or flushing the tube in a hot (180 to 200 degrees F.), 10 to 20 per cent solution of trisodium phosphate or sodium carbonate, and rinsing in water.

Sand used as a filler for hot-bending nickel and high-nickel alloy tubing must be sulphur free, or nearly so. Cases are on record where the use of sand containing as little as 0.012 per cent sulphur embrittled the tubing at hot-bending temperatures and rendered it useless. An example of such a case is shown in the lower view of Fig. 2. Washed and kiln-dried, high-silica sand is suggested for hot-bending the high-nickel materials. Residual sulphur may be burned out of the sand by spreading it thinly on a plate or pan of heat-resisting alloy and exposing it to an oxidizing atmosphere at about 2100 degrees F.

The suitability of a sand as regards its embrittling effect on the high-nickel materials can be determined by intimately exposing a small thin-gage sample of the nickel in the sand at elevated temperatures (about 2000 degrees F.) for about ten minutes, and making a bend test on the sample when it has cooled to room temperature. If no minute cracks develop in the bend surface after bending the sample through 180 degrees—flat on itself—it is reasonable to assume that the sand is suitable filler.

The hot sample should be quenched in a water-alcohol solution containing about 2 per cent alcohol. If air-cooled, a tenacious, continuous film of oxide would form on the surface, which would make it less easy to inspect the material over the radius of the bend.

Prior to hot-bending, the tube is filled with sand, after first plugging one end and tightly ramming in the fine sand that has been heated previously to drive out all moisture. The other end of the tube is then plugged tightly. The filled tube is now ready for heating. Thorough removal of all moisture from the sand is important before hot-bending; otherwise, steam formed during heating might cause sufficient pressure to burst the plugs or tube.

Rod-heating furnaces, open front and back and fired with gas or oil from one or both ends, are commonly used for heating tubing for hot-bending. Sulphur-free fuels or fuels containing low amounts of sulphur are essential for heating nickel and the high-nickel alloys. As previously mentioned, sulphur embrittles these materials at elevated temperatures.

Sulphur-free natural gas is a very satisfactory fuel. Manufactured gas containing up to 15 grains total sulphur per 100 cubic feet is known to be satisfactory; and there are cases where manufactured gas containing as much as 30 grains total sulphur per 100 cubic feet has been found suitable. It is considered that this higher level of sulphur content is marginal, however, especially if heating time is extended and the material is nickel instead of high-nickel alloy.

Fuel oil used for heating the high-nickel materials should never contain more than 0.5 per cent sulphur; light distillate Grades 1 and 2 fuel oils are suitable.

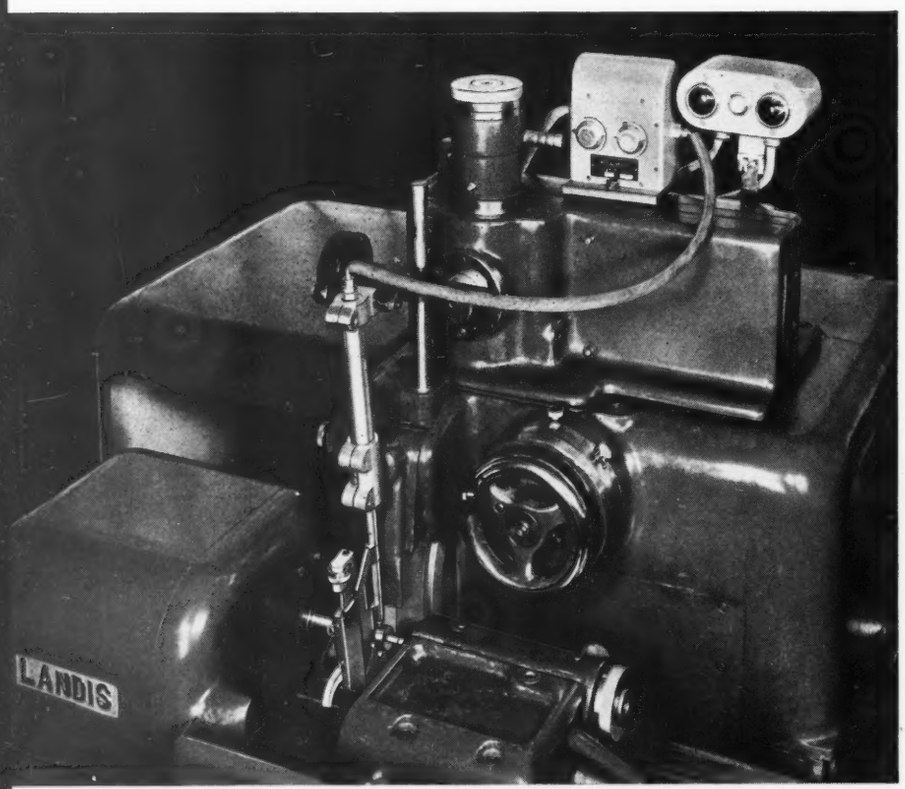
The tubing should be heated as rapidly as possible without soaking. The burner setting of the furnace should be kept on the reducing side—that is, it should be adjusted to maintain at least 1 to 2 per cent carbon monoxide in the combustion products. Flames should not be permitted to impinge on the tube. The tube should be supported above the hearth of the furnace and rotated frequently as it is heated. The best temperature range for hot-bending nickel and Inconel is 2250 to 1900 degrees F., and for Monel, 2150 to 1850 degrees F.

If the furnace design does not permit keeping the wooden plugs out of the fire, a disc, preferably of the same composition as the tube, can be welded in the ends to confine the sand. An extra allowance of 1/4 to 1/2 inch in length should be provided at each end closed by welding for removal of the discs.

The second, and concluding article on this subject, to be published in September MACHINERY, will deal with the welding and brazing of seamless nickel tubing.

* * *

Trustees of the National Tool and Die Manufacturers Association, meeting in Cincinnati recently, proposed a change in Government draft policy as one solution of the skilled manpower shortage. Their idea is that the Government should recognize the importance of training in the tool and die field and revise draft regulations so that apprentice training in that field will be considered as important as college work. Under such conditions, tool-room apprentices would be allowed to complete their technical training before being subject to draft.



Landis cylindrical grinding machine equipped with an Etamic pneumatic sizing device for automatically controlling the work size. This attachment, made by Ateliers de Normandie, Paris, France, stops the grinding operation automatically when the diameter of the work reaches a pre-set value. The jaw-shaped gage in contact with the work is equipped with two carbide supporting tips and a contact finger that blocks off air from a vent above the work, the movement of the finger being proportionate to the diameter of the part being machined

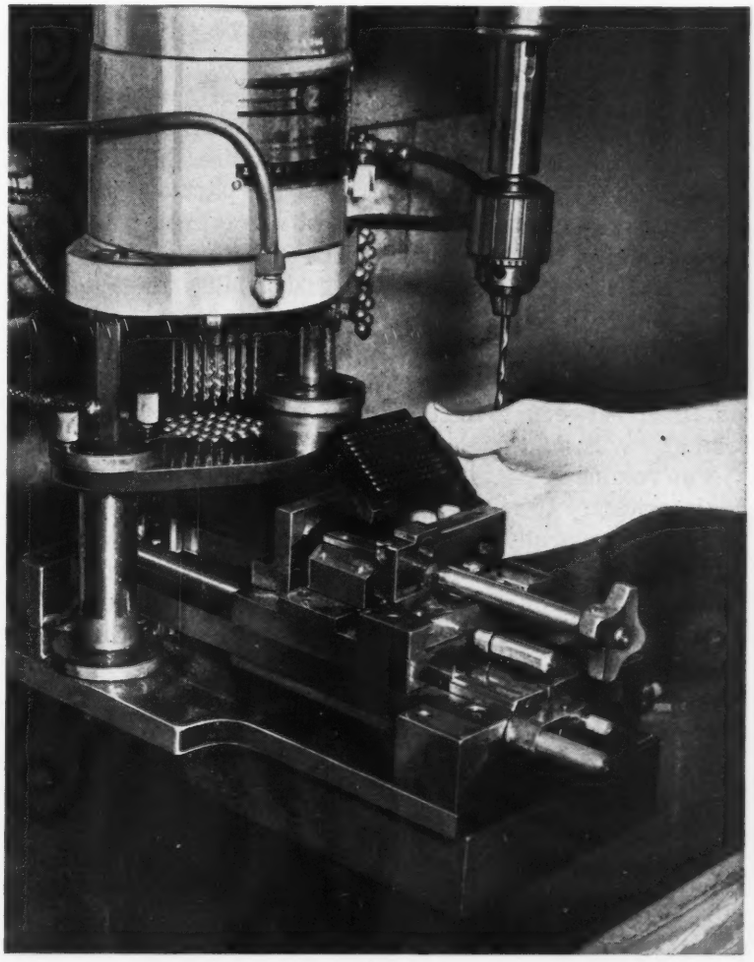
Multiple Drilling of Small Closely Spaced Holes

Among the numerous complex parts employed in products built at the Poughkeepsie plant of the International Business Machines Corporation is one known as an "emitter block." This is a phenolic molding containing 110 nickel-silver inserts, spaced in ten rows of eleven each. It is necessary to drill a hole in each insert, and the holes must be spaced on 3/8-inch centers. Each hole is drilled to a depth of 1/4 inch by a 1/16-inch drill, and the diameters of the holes must be held to 0.061 + 0.003 — 0.000 inch.

Obviously, it would take too long a time to drill all these holes singly. How the job was handled in one set-up is shown in the accompanying illustration. Twenty drills are employed, arranged in five rows of four each on 3/4-inch centers. This is close spacing, considering the fact that each drill must be mounted in a separate holder, and it would be difficult or impossible to obtain in a conventional geared drill head. For this reason, a Zagar gearless type drill head is used. Each drill is guided by a hardened bushing in a drill jig which, of course, helps in maintaining precise center distances.

As there are only twenty drills, they must be fed six times to produce the 110 holes. In one of the six feedings, only ten holes are produced, the other ten drills entering holes previously drilled. To drill in this pattern and still hold the required 3/8-inch center distances with drills on 3/4-inch centers, the work has to be precisely located before each drilling operation. This is accomplished by clamping the work in a fixture that can be moved forward and backward, as well as transversely. With this arrangement, the gearless drill head remains in a fixed position (except, of course, for vertical feeding motion), and the drill jig is not moved at all.

With the 3/4-inch drill spacing, the holes are produced in alternate rows. After first drilling twenty holes in odd numbered rows at one side of the block, the work is shifted 3/8 inch forward and the remaining holes in these rows are drilled. Then the work is shifted sidewise and the holes in another set of four rows are drilled. Similar shifts are made until all the 110 holes are drilled. A crank-operated cam actuates the fixture and locates it positively at each resetting, thereby insuring correct center spacing.



Set-up for drilling 110 holes on 3/8-inch centers in the inserts of the molded phenolic block shown being removed from the fixture. A gearless head holding twenty drills is fed six times to complete each piece

* * *

Cam Design Charts Offered by New York University

A folder entitled "Radial Disc Cam Design Charts for Maximum Pressure Angle" is available from the New York University College of Engineering. It tells how to design cams so as to have the proper angle between the cam surface and the radial roller or knife-edge follower. A sample problem is worked out, and four charts are included to cover simple harmonic motion, constant acceleration motion, constant velocity motion, and cycloidal motion.

Copies can be obtained from V. W. Palen, Bureau of Public Information, New York University College of Engineering, New York 53, N. Y., by enclosing 10 cents to cover cost of handling and mailing.

Designing

Essential Factors to be Considered in Designing and Applying Carbide Dies for Economical Punch Press Operation, Including Selection of Correct Grade of Carbide to Suit Different Types of Work, and Proper Maintenance of Dies

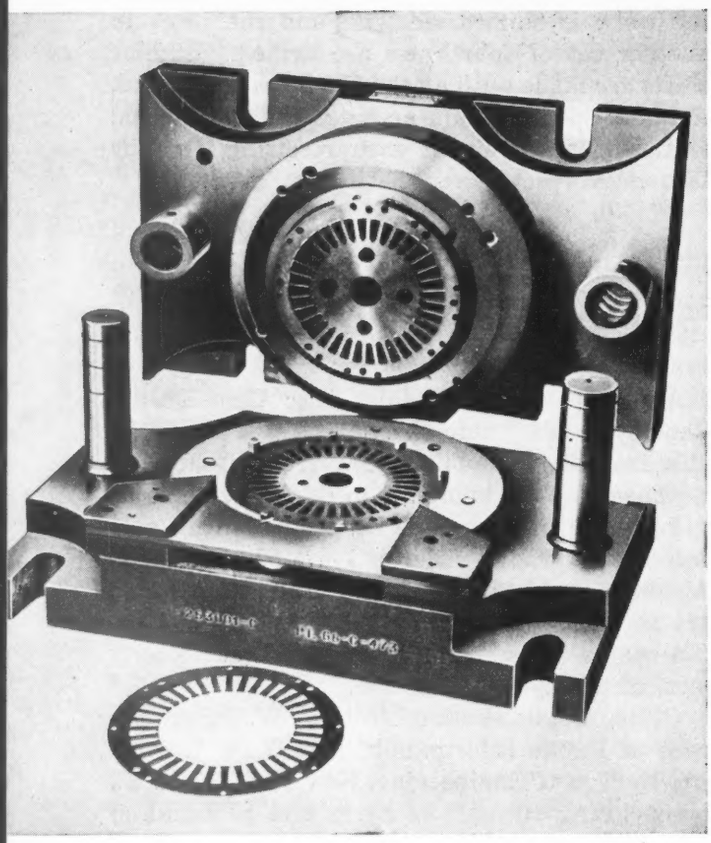


Fig. 1. Carbide compound die designed to blank and pierce rotor laminations for electrical motors from silicon steel

SUBSTANTIAL increases in the use of carbide dies for blanking, piercing, forming, and drawing of various materials are the result of a better understanding on the part of stamping producers of the inherent advantages of carbide as a die material. The outstanding characteristic of carbide dies is their ability to resist abrasive wear, retain a fine surface finish, and withstand the shock of repeated impact on their working edges and surfaces. The long life obtained between grinds permits high production at low cost.

The volume of parts to be made need not be too high to justify the increased cost of carbide dies (which is generally from two to four times that of steel dies). Greater cost is offset by the advantages mentioned, in addition to improved quality of the work and the elimination of subsequent operations. Another economic advantage of carbide dies is their low regrinding cost per work-piece. For example, the cost of regrinding a typical carbide die is $40, while the cost of regrinding a comparable steel die is $25. However, the carbide die will produce up to eight times as many parts between grinds, and has a total life at least twenty times longer.

In considering the application of carbide dies to punch presses, careful study must be made of the following factors: Proper grade of carbide to use; kind of material to be worked; design and construction of the die; method of mounting; type of press to be used; lubrication; and grinding and maintenance of the die. Some of the more important points to be considered in designing and applying carbide dies for economical punch press operation will be described in this article.

Selection of Carbide Grade

Most carbide manufacturers produce several different grades to meet the requirements for various applications of carbide dies. "Diecarb," the Firth Sterling sintered carbide developed expressly for use in compound dies, combination and progressive dies, slitter knives, and wear resisting parts, is made in five grades. The hardness, composition, and strength of the different grades (see Table 1) determine their applications. The principal difference in the grades is the ratio of toughness to wear resistance, the ability to resist wear being more important in some applications than shock resistance.

Chemical and physical properties of the material to be worked determine the forces to which the tooling will be subjected. Such forces are

Carbide Dies

By M. J. BLACKSTROM,
Assistant Chief Engineer
and
E. J. REITLER
"Diecarb" Engineer
Carbide Divison
Firth Sterling Steel & Carbide Corporation
Pittsburgh, Pa.

Fig. 2. Carbide combination die for blanking bottle screw caps at one station and drawing them at a second station

generally compressive—rarely tensile. Since the compressive strength of sintered carbide exceeds that of any known material, it is ideally suited for such applications.

Considerations in Designing Carbide Dies

The use of several simple formulas will aid in designing the dies and in determining the proper grade of carbide to be selected for a given application. For example, the following formula may be used to determine an approximation of the compressive force to which the punch will be subjected. (The compressive strength of "Diecarb" may be taken, for calculation purposes, as 400,000 pounds per square inch.)

$$C = \frac{P}{A}$$ where

C = compressive force to which tooling will be subjected;
P = blanking or forming pressure; and
A = plan area of punch.

The blanking pressure may be calculated by the equation:

$$P = B \times S \times T \times K$$ where

B = perimeter of section to be blanked;
S = shearing stress of material to be blanked;
T = thickness of material to be blanked; and
K = percentage of penetration required to effect fracture.

The percentage of penetration required to effect fracture of various materials is given in Table 2. It must be remembered that dull cutting edges, improper shear, roughened or scratched drawing surfaces, and lack of lubricant all add to the calculated load.

A common method of reducing the maximum load on the cutting edge of a punch or die is to incorporate angular shear. The purpose of angular shear is to effect a reduction in the peak load by shearing a little at a time rather than taking the entire cut at once. An empirical formula for calculating the effect of angular shear is as follows:

$$P = \frac{T \times K \times P \text{ max.}}{I}$$ where

P = actual blanking pressure;
P max. = calculated blanking pressure without shear; and
I = total inclination or shear of punch or die, in inches.

Table 1. Hardness, Analysis, and Strength of Various Grades of Carbide

Diecarb Grade	Characteristics	Hardness, Rockwell		Analysis, Per Cent			Ultimate Strength, Pounds per Square Inch		Die Applications
		C Scale	A Scale	Tungsten Carbide	Cobalt	Tantalum Carbide	Compression	Shear	
DC-1	Light shock and high wear resistance	76.0	90.5	94	6.0	...	480,000	260,000	Blanking of thin or ductile materials
DC-2	Medium shock and good wear resistance	73.0	88.5	87	13.0	...	414,000	350,000	For thicker materials
DC-X	Combines greatest degree of toughness with wear resistance	72.0	88.0	85	15.0	...	400,000	360,000	For blanking silicon steel laminations
DC-3	Tough, but not quite so wear-resistant	69.0	86.0	75	20.0	5.0	391,000	.....	For coining die sections
DC-4	Extreme toughness and more wear-resistant than high-speed steel	65.0	84.0	70	25.0	5.0	354,000	.....	For die sections subjected to high compressive stresses

Angular shear, when incorporated in dies and punches constructed of carbide, should be equal to twice the material thickness for materials under 1/16 inch thick. For materials over 1/16 inch thick, the angular shear should be equal to the thickness of the material.

Clearance between the punch and die will affect to some degree, the pressure required, but it has an even more important effect on the quality of the work produced. This clearance varies for different materials. Actual values may be from 5 to 12 per cent of the material thickness. The accepted values for the most common materials are 5 to 7 per cent of the material thickness for brass and soft rolled steel; 7 to 10 per cent for medium hard rolled steel; and 9 to 12 per cent for hard rolled steel.

Clearance angles must be incorporated in the die to provide a gradual increase in the area of the die opening. This permits escape of the blanks as they are cut, eliminating wedging and jamming as the successive blanks are passed through. Also, it is essential to provide at least a nominal amount of cutting rake clearance.

A taper of 1/2 degree is generally used for the clearance angle. While this value may seem low to the inexperienced designer, it does furnish the necessary clearance, and at the same time, permits grinding an appreciable amount of stock from the face of the die for resharpening before the opening is large enough to produce an oversize blank.

The smallest cross-sectional dimension of the punch should not be less than the metal thickness, and punches of too slender a design should be avoided. The latter may be accomplished by maintaining a length to thickness ratio of unsupported carbide not greater than 3 to 1.

The three basic types of press tooling are compound, combination, and progressive dies. The compound die, Fig. 1, is generally classified as a cutting tool, in that the blanking and piercing work is entirely a cutting process, accomplished with a single stroke of the press. The combina-

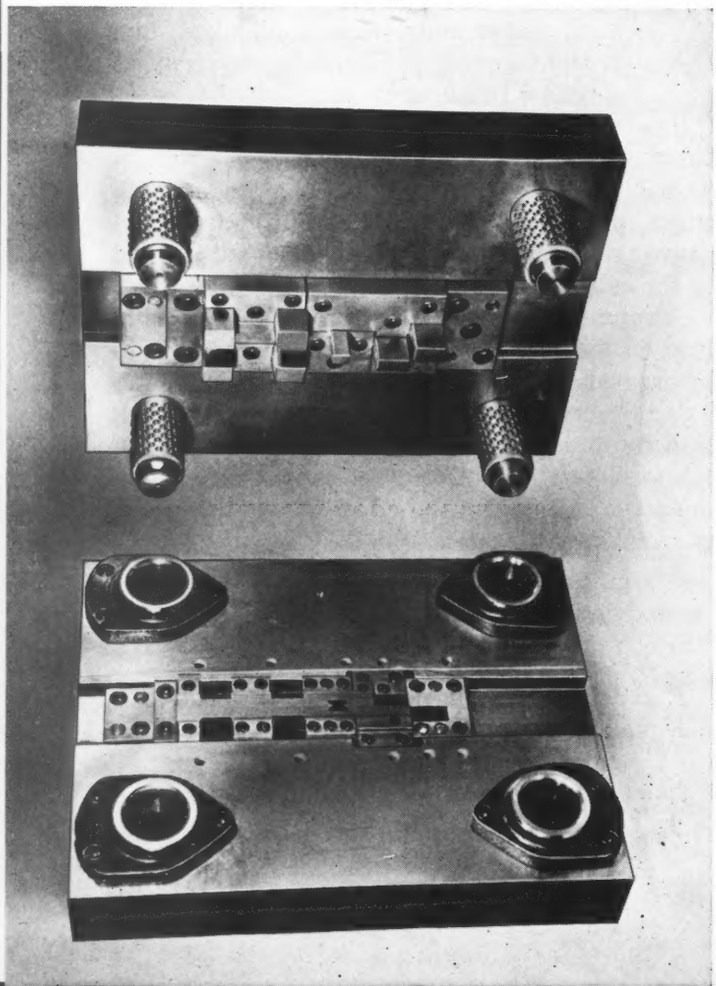


Fig. 3. Segmental construction is employed in this carbide progressive die for blanking electrical motor commutator segments

Table 2. Penetration Required to Effect Fracture in Blanking Various Materials

Material to be Blanked	Tensile Strength, Pounds per Square Inch, when Annealed to Soft Temper	Penetration, Per Cent of Thickness, Required to Effect Fracture	Tensile Strength, Pounds per Square Inch, when Cold-Worked	Penetration, Per Cent of Thickness, Required to Effect Fracture
Aluminum	8000 to 14,000	60	13,000 to 42,000	30
Brass	22,000 to 36,000	50	42,000 to 52,000	20
Lead	3500	50		
Monel	35,000	55		
Steel				
Low-carbon	50,000	40	60,000	25
Medium-carbon	70,000	25	90,000	15
High-carbon	120,000	10	150,000	5
Silicon	65,000	30		
Stainless	60,000	40		
Tin	5000	40		
Zinc	15,000	50	20,000	25

tion die, Fig. 2, is employed for blanking and forming or for blanking and drawing. Each of the two operations is performed at a single station with a single or successive stroke of the press. The progressive die, Fig. 3, comprises a series of compound or combination dies which accomplish several operations simultaneously, and, in effect, enables a single press to do the work of several presses.

It has been standard practice for years to make progressive, compound, and combination dies of steel, using segmental construction. In most cases, inserts of the same design are desirable in carbide dies. Since internal grinding of carbide is costly, it is best to split the segments in such a way as to permit surface grinding. A further economy resulting from the segmental insert construction is that it reduces considerably the cost of replacement when a portion of a die is worn, chipped, or otherwise damaged.

Construction of Carbide Dies

Carbide die sections and punches can be brazed, shrunk, wedged, keyed, or bolted to the matrix of the die. For blanking operations, however, mechanical methods of holding are superior to brazing or shrinking. During the early period of development, when carbide was considered a luxury, punches were designed with a small section of carbide brazed at the cutting end, similar to the practice followed in making carbide-tipped cutting tools. It was found, however, that the available brazing materials were inadequate to withstand the continued forces of impact due to work-hardening, and failure of the application could be directly attributed to that cause. For that reason punches with brazed ends are seldom used in present practice.

Shrink fitting of carbide inserts should be restricted to cylindrical shapes, as seen in Fig. 4. This is due to the fact that other shaped parts will produce unequalized shrinkage in various directions. Shrink fits are generally employed for securing carbide sections of drawing dies. Recommended interferences for cylindrical shrink fits are given in Table 3.

Mechanical Holding Methods

Wedge type construction includes grinding a slight taper—usually 3 to 5 degrees—on the outer contour of the carbide insert and a matching taper on the steel wedge, as seen at the left in Fig. 5. The wedge is then drawn in between the matrix and the carbide section with cap-screws. The cap-screws fit into counterbored holes in the wedge to prevent interference in the operation of the die. Care must be exercised to

Table 3. Recommended Shrinkage Allowances For Round Carbide Inserts

Outside Diameter of Carbide Insert, Inches		Shrinkage Allowance, Inch
Min.	Max.	
0.437	0.562	0.0013 to 0.0018
0.562	0.687	0.0016 to 0.0021
0.687	0.812	0.0021 to 0.0026
0.812	0.937	0.0025 to 0.0030
0.937	1.125	0.0028 to 0.0033
1.125	1.375	0.0035 to 0.0045
1.375	1.750	0.0038 to 0.0048
1.750	2.000	0.0043 to 0.0053
2.000	3.000	0.0045 to 0.0055
3.000	3.500	0.0055 to 0.0065
3.500	4.000	0.0065 to 0.0075
4.000	5.000	0.007 to 0.008
5.000	6.000	0.008 to 0.009
6.000	7.000	0.009 to 0.010

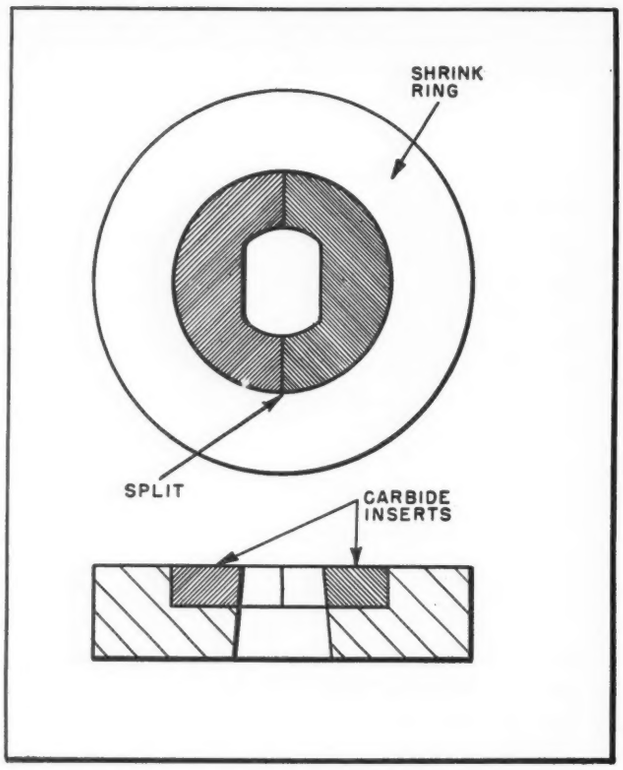


Fig. 4. One of the methods used in shrink-fit die construction. Here a split carbide insert is held in a counterbored steel casing

secure a neat fit, since the wedge not only locates the insert, but also provides the necessary support to the carbide.

Certain product designs may dictate the necessity for bolting the punch or die insert directly to the matrix. A satisfactory method for this type of fabrication includes the insertion of a mild steel or bronze section into the carbide to facilitate threading and fastening, as seen at the right in Fig. 5. When the fastener section is small, it may be secured to the carbide by brazing, preferably with a low melting alloy. When the fastener section is internal and greater than 1/2 inch in diameter, brazing is not recommended for sections that are constructed in a single piece.

In the case of fastener sections over 1/2 inch in diameter, the method shown in Fig. 6 should be used. By breaking down the fastener section into four parts as shown, the expansion of each part will be less than if the section were of one piece. The low linear coefficient of expansion of carbide (3.4×10^{-6} per degree F., as compared to 6.8×10^{-6} per degree for steel) dictates the precautions that must be exercised when bonding carbide to steel by the use of heat. When the steel fastener sections are divided into segments, the layer of brazing material can more readily accept the expansive forces caused by heat and the contrasting coefficients of expansion.

Mechanical holding of carbide sections should be employed whenever possible. A typical example of a mechanically held carbide punch is shown at the left in Fig. 7. Keys are used principally for holding either fixed or floating type punches, as seen in the center of Fig. 7. In employing this means of holding, the grinding of deep grooves or sharp re-entrant angles on the punch should be avoided.

To minimize the danger of punches snapping off due to misalignment, floating type punches may be used. As a means of increasing the factor of safety where the design of the product requires the use of a long, slender punch, a carbide quill or bushing should be used to support the punch, as seen at the right.

In the past few years, the pillar type of subpress assembly construction has gained popularity for steel dies. The increased production and performance possible when carbide is used

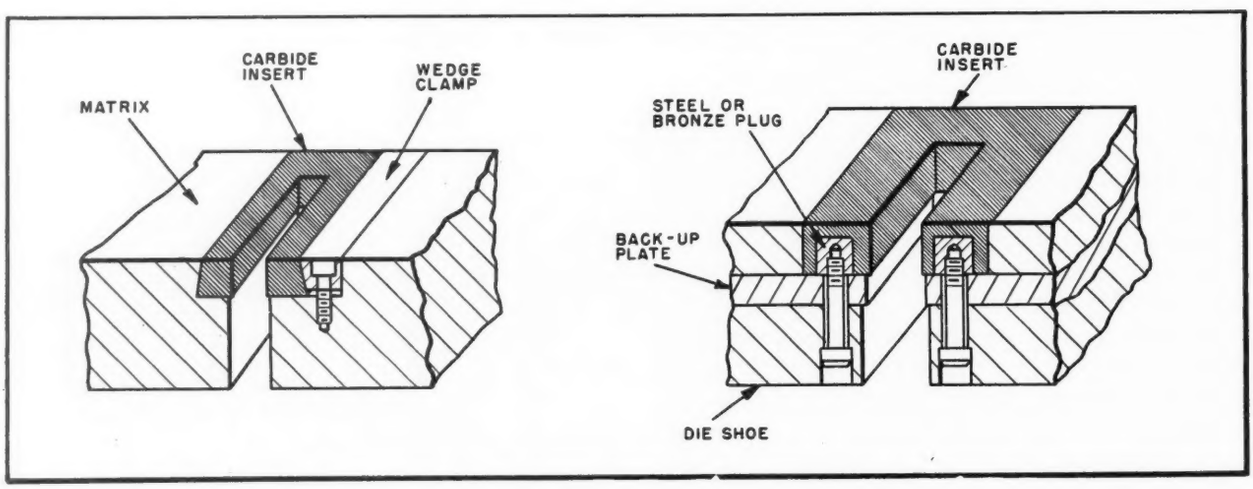


Fig. 5. Two methods of mechanically holding carbide inserts to the matrix of a die. At the left is shown the use of a wedge clamp and at the right small plugs brazed to the carbide and bolted to the die shoe

makes this type of construction most desirable for carbide dies also.

A recent development gaining rapid acceptance in sub-press assembly construction is illustrated in Fig. 8. Here it will be noted that balls mounted in cages are fixed to the posts. The posts ride in steel or bronze sleeves having a bore 0.0015 inch smaller than the diameter over the balls. In operation, this results in the rapid wearing of shallow grooves in the sleeves and posts, thus assuring constant alignment.

Manufacture and Maintenance of Carbide Dies

Owing to the extreme density and hardness of carbide, manufacturing processes differ to some extent from those used in the fabrication of steel dies. Rather than finish the desired shape completely from a solid section of fully sintered carbide, it is the practice at Firth Sterling to rough-shape the die section while the carbide is in the "half sintered" condition. Tolerances are held reasonably close in this "roughing" operation, so that only a minimum of stock need be removed by the fabricator to produce the final size. The stock allowance depends upon the shape of the die section and the particular grade of carbide ordered, since the shrinkage encountered in sintering varies with these factors.

Conventional grinding machines, and some special contour grinders, as well, are used to reduce the sections to their final shape and finish. Grinding wheel recommendations also depend to a great extent upon local conditions. However, in general, a 100-grit, 100 per cent concentration, vitrified-bond diamond wheel would be used for roughing, and a 220-grit (or finer) vitrified-bond wheel for finishing.

A new method of fabricating hard metals, developed by Firth Sterling, permits fastening carbide sections directly to the matrix by means of screw fasteners fitted into the solid carbide sections. Threaded holes are made in the fully sintered carbide sections, eliminating the need for built-up steel wedging, clamping sections, or brazed-on fastening devices.

Method X, as the new method has been tentatively named, also opens the way for an entirely new concept in the design of carbide die sections.

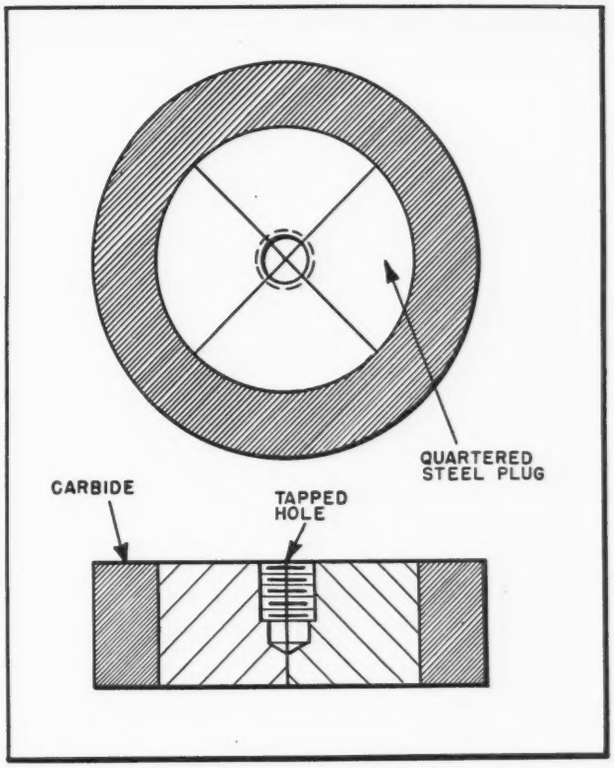


Fig. 6. By making the internal fastener for holding the carbide in a die in four sections, expansion is decreased when the steel is brazed to the carbide

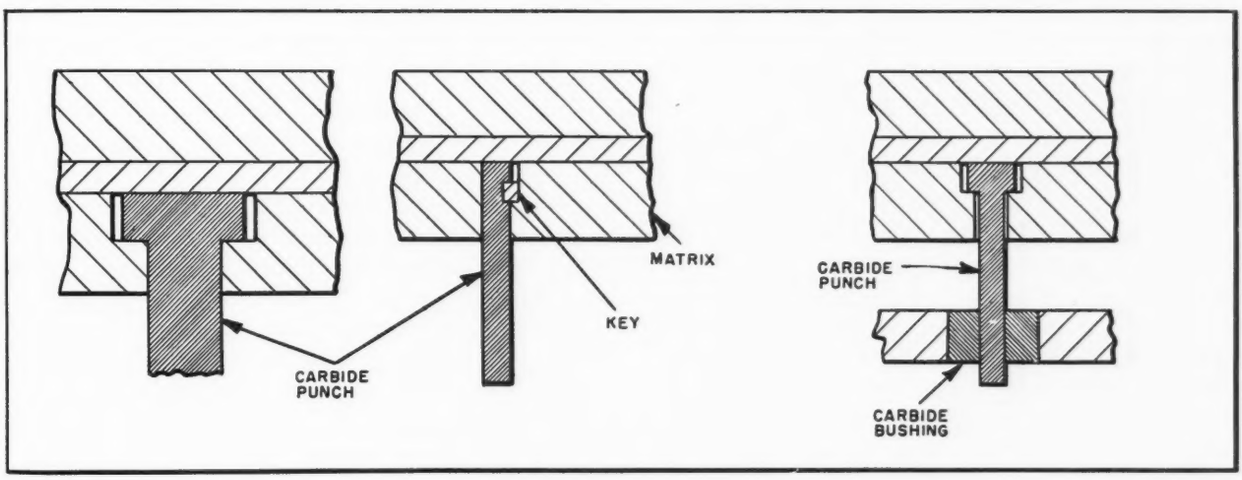


Fig. 7. Alternative methods of mechanically holding carbide punches to the die matrix. A key (center) can be used to hold either fixed or floating type punches. In the view at the right, a carbide bushing supplies additional support for the long, slender punch

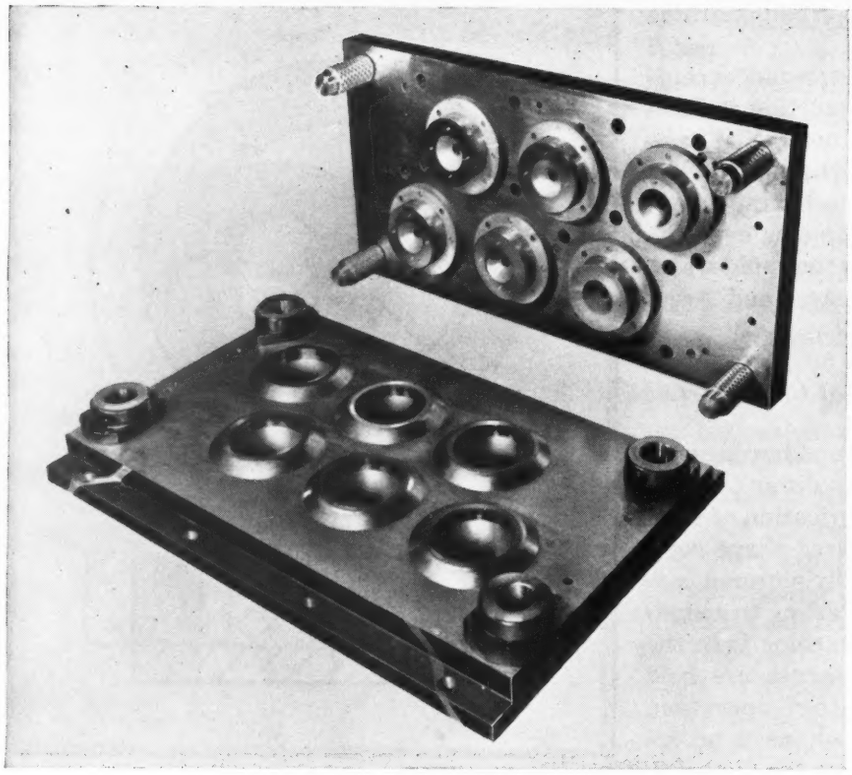


Fig. 8. Sub-assembly type of carbide die in which balls mounted in cages fixed on the posts form grooves in the die bushings to insure accurate alignment of the die members

Intricacy is no longer an obstacle to the forming of exterior and interior shapes. Through or blind openings from 0.003 to several inches in diameter, in rectangular, oval, triangular, round, square, symmetrical, or unsymmetrical shapes are readily produced. Internal corners can be formed sharp within 0.002 inch or made with any specified radii. Splined holes used for compacting or extruding dies can be accurately located, with center-to-center distances held to close tolerances. Engraved lettering, or special shaped engraving, can be produced.

Upon occasion it may be necessary to lap the working surfaces after assembly. Diamond powders with olive oil as a carrier, rubbed on the surface of the carbide by means of a block of soft steel or wood or a pad of copper braid or cotton, will accomplish the desired results. A minimum of lapping should be done to prevent the possibility of forming a reverse taper on the section.

The die should be reground when a maximum of 0.003 to 0.005 inch of stock removal is required for resharpening. It is false economy to try to obtain an additional 50,000 to 100,000 blanks before resharpening, as this will probably cause chipping of the carbide and require the removal of as much as 0.015 to 0.020 inch of stock.

Most stamping and blanking operations are performed on three basic types of equipment—the vertical or inclinable press, the "dieing" machine, and the multiple-slide machine. Variations in press design include both mechanical and hydraulic operation, with upright, inclined, or horizontal die positions.

Regardless of the style or type, presses on which carbide dies are employed should be rigid, properly aligned, and have an accurate and efficient feed mechanism, combined with sufficient speed and power. Whether dies are built from steel or carbide, the largest quantity and best quality blanks can be produced at the lowest cost and in the shortest time with well maintained press equipment. The quality or type of die set may overcome certain press limitations, but maximum production can only be obtained with a well maintained press.

The inherent density and compressive strength of sintered carbides, combined with their ability to take and hold a high polish, greatly reduce pick-up and facilitate stripping. This allows much higher press speeds and greater feeds than are permitted with steel dies. Although high press speeds are not mandatory for the use of carbide dies, there is definite indication that increased use of carbide for blanking will result in the design of super-speed presses.

There is already a trend in this direction. For example, the Lempco press operates at speeds up to 1800 strokes per minute, with a stock feed of 10,000 inches per minute on the 50-ton model. Without the use of carbide dies, this type of equipment would be impractical, due to the frequent regrinding necessary with steel dies.

Transparent Cutting Oils Offer Important Advantages

By J. C. VAN GUNDY
Technical and Research Division
The Texas Co.
Chicago, Ill.

THE primary advantage of transparent cutting oils is that the operator can observe the cutting tool and work-piece through the fluid. This is highly important in certain metal-working operations, particularly when extreme accuracy and fine finish are desired. Inspection of the parts produced can thus be more easily accomplished, since the finished work can be seen through the oil film, and does not have to be washed off in a solution before being inspected. This is particularly true in handling small parts on automatic screw machines. In using a transparent cutting oil, the machine inspector can check the parts produced by this type of machine (see Fig. 1) with a minimum of delay.

Another advantage gained by using a transparent cutting oil is that the shop operating conditions are cleaner. It has been reported by users that a clear oil has a psychological effect on the workers, and that they naturally become more careful in accomplishing their tasks. Strange as it may seem, generally better shop housekeeping is practiced at no extra cost in cases where a transparent oil is used. This, of course, also results in decreasing the ultimate cost of production.

Cutting oils, as used for many years, have contained sulphur, chlorine, and sometimes other additives in various forms or compounds for the purpose of reducing frictional heat developed during the machining of steel or its alloys. Unfortunately, such additives have a tendency to darken the oil. In fact, the highly compounded oils necessary in the most severe broaching, threading, tapping, and similar operations are usually very dark, or even black in color.

Heretofore, when it was necessary to use transparent cutting oils on the operations just mentioned, tool life was reduced, surface finish impaired, production decreased, and tool costs increased because it was impossible to secure a transparent cutting oil possessing the characteristics and properties of the dark or "black" type cutting oils. As a result of extensive research,

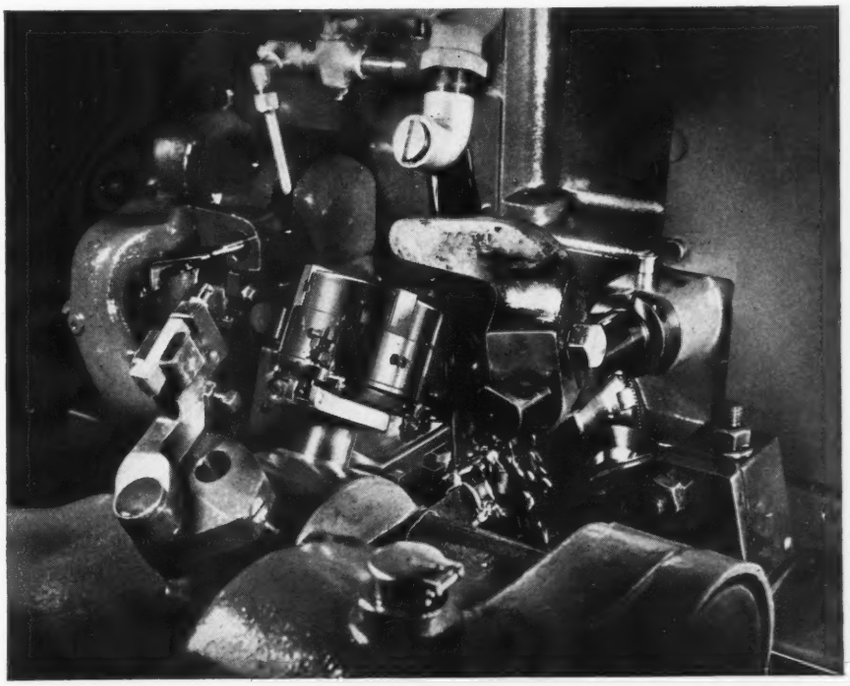


Fig. 1. Use of a transparent cutting oil on automatic screw machines facilitates inspection of the parts being produced

however, transparent cutting oils have been developed that are suitable for the great majority of machining operations taking place today.

Active Type Sulphurized Cutting Oils

Sulphurized cutting oils are not a cure-all for metal-cutting difficulties. In fact, certain conditions and some metals prohibit their use. For example, active type sulphurized oils are not suitable for machining brass, copper, or non-ferrous alloys, due to the fact that the active nature of the sulphur causes the surfaces of these metals to turn black. For such metals, special non-corrosive oils have been developed. In most cutting operations today, with the exception of those requiring soluble oil emulsions, some form of sulphurized oil is used.

During recent years much progress has been made toward maintaining transparency while increasing the sulphur content of cutting oils. Such oils have been used extensively on milder cutting operations for several years. As a result of continued research, however, improved products have been made available which today not only are transparent but also contain enough additives to enable them to handle most of the tough machining operations for which dark oils were formerly required. Some of the more interesting properties of these newer transparent cutting oils will be described in the following.

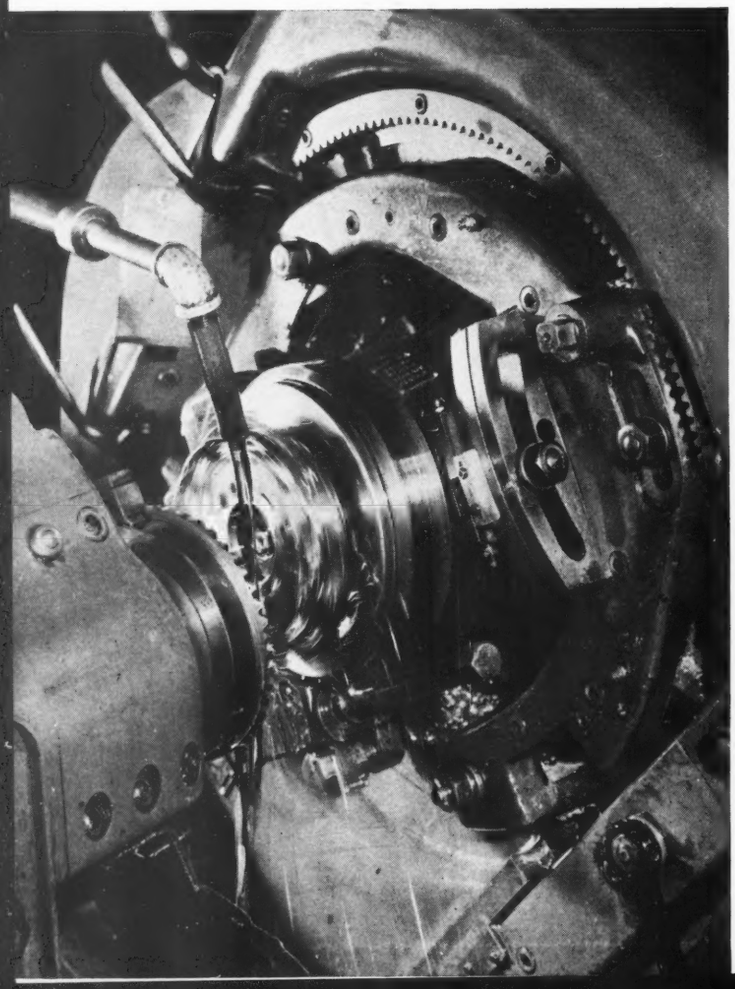


Fig. 2. Operator can clearly see the gear tooth cutting tool during the machining operation when a transparent oil is used

The transparency of modern, high-sulphur content cutting fluids is clearly shown in the accompanying illustrations. With the newer transparent, high-sulphur content, active cutting fluids, many machining operations are now being efficiently handled that were only possible to accomplish with dark or "black" cutting oils. For example, in a case where a "black," highly sulphurized oil had been used to thread bolts of S A E 1010 steel and studs of S A E 1015 steel, tests showed that a modern transparent oil could be used for the same application with no loss in threading die life.

In another application, parts were machined from 3/8-inch round bars of S A E 1015 steel at spindle speeds of 3000 R.P.M. with a 0.003 inch feed on an automatic. Three oils were tested on a comparative basis, two "black" oils and one transparent oil—all of the active type and all highly sulphurized. The transparent oil was found to be equal in performance to one "black" oil and very slightly inferior to the second one.

In a third application, push-rods of S A E 4140 steel were being threaded at speeds of 60 to 63 feet per minute. With a high quality "black" oil, 700 to 750 push-rods were threaded, whereas with a new transparent oil 500 to 550 push-rods were threaded between chaser regrinds. The interesting part of this test was that with the best transparent oil available until recently, only 200 to 250 rods were threaded between chaser regrinds.

These three illustrations of actual fluid performance show what can be expected of the new active type transparent cutting oils. While they may not yet quite equal the best of the "black" oils in cutting performance, they are far superior to the transparent oils available a short time ago.

Transparent cutting oils of the active type have outstanding advantages in the applications for which they are suitable. They dissipate heat rapidly, provide more efficient operation, minimize "carry off," and readily separate from chips and contaminants.

Non-Corrosive Type Cutting Oils

As a result of research, however, sulphurized cutting oils are now available that are non-corrosive to copper and its alloys at reasonable temperatures. An example of a copper strip that was immersed in this new non-corrosive type of sulphurized oil is shown at the left in Fig. 5. The

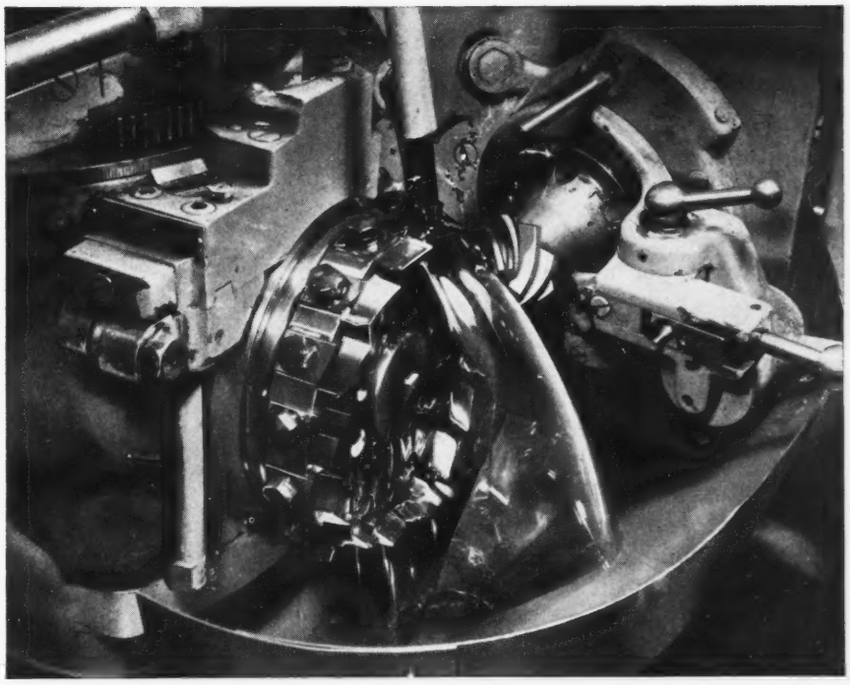


Fig. 3. This view of a gear machining operation shows the clarity of the oil film as it passes over the cutting tool and work

sample shown at the right was immersed in active sulphur cutting oil. These non-corrosive oils are suitable for all types of machinery operations on the milder steels and on non-ferrous metals. They do not, however, possess properties that adapt them for tough machining jobs.

Some non-corrosive sulphurized cutting oils have such exceptional properties that their use has extended beyond that of cutting fluids. An example of such an application is found in automatic screw machines. In these machines, the cutting fluid sometimes becomes mixed with the oil from the machine lubricating system or the hydraulic system due to leakage, and is diluted. Such dilution may result in poorer cutting performance and tool life.

This problem is solved by the use of one product as both a cutting fluid and machine oil, and also as the hydraulic medium, if the machine is so equipped. From these uses, the names "dual" or "tri-purpose" oils are derived. Specifically, in such applications, certain non-corrosive sulphurized mineral oils can be used with satisfaction for each machine function.

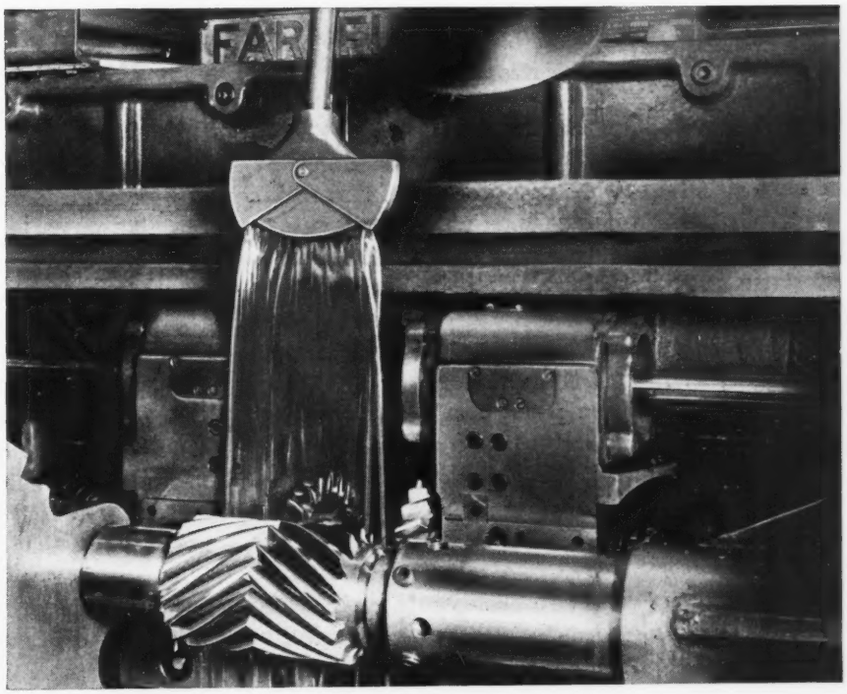


Fig. 4. Transparent, active type sulphurized cutting oil permits clear view of herringbone pinion being machined and cutter. Cleaner working conditions are also obtained

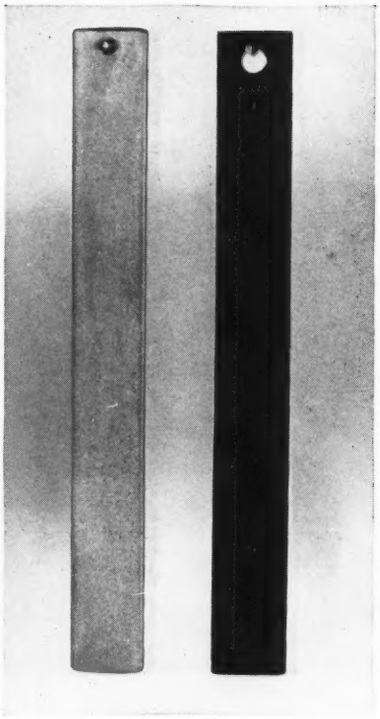


Fig. 5. Two highly polished copper strips that were immersed in cutting fluids for one hour at room temperature. The strip at left was immersed in non-corrosive fluid, and the other in active sulphur cutting oil

Even when the nature of the work requires the use of an active type, sulphurized cutting oil, a non-corrosive sulphurized cutting oil can be employed for both the machine lubricant and the hydraulic system in automatics where leakage is a problem. The reason for this is that dilution of the cutting fluid with the non-corrosive sulphurized cutting oil does not have nearly as harmful an effect as that resulting from dilution with a mineral lubricating or hydraulic oil. Therefore, the cutting fluid can be used for a much longer time, efficiency is increased, and tool life is extended.

The use of "dual" or "tri-purpose" oils has been singularly successful in both single- and multiple-spindle automatic machines. In using such products, however, it cannot be stressed too strongly that only new oil should be used in the machine lubricant reservoir and hydraulic system. Reclaimed oil undoubtedly contains finely divided particles of metal, and should not be used for lubrication of any parts of the machine or hydraulic system.

Transparent Oils Used in Grinding Operations

During recent years there has been a steady growth in the use of oils for grinding because of certain advantages, one of which is transparency. Grinding oils are particularly advantageous in form and thread grinding because rate of wear and breakdown of the wheel are minimized. The longer wheel life obtained results in decreasing wheel-dressing costs and increasing the efficiency of the grinder.

The use of oil also permits a faster grinding rate—and the surface finish and the accuracy obtainable are excellent. Another advantage of oil is the reduced tendency toward rusting. All of these factors combine to reduce the unit cost of the finished part.

However, oils have two disadvantages that may prevent their adoption for all forms of grinding —at least under present conditions of operations. Oils cannot dissipate heat as rapidly as soluble oil emulsions, and hence for certain types of grinding operations where an excessive amount of heat is generated, the use of soluble oil emulsions may be necessary. A second handicap is that mist may be formed with oil. This constitutes a fire hazard, which, however, can be alleviated by specially designed equipment.

Transparent Soluble Oils Have Limited Application

The great majority of soluble oil emulsions on the market today are milky in appearance. There are a few special applications, however, where transparency of the emulsion is a definite advantage. These include certain types of surface grinding, where it is desirable to observe the exact progress being made—for example, in the grinding of parts having a shoulder.

Transparent soluble oils, however, have certain limitations. They are normally synthetic detergents. The term "synthetic" as applied to such soluble oils means that these products do not contain any petroleum type oils. These soluble oils are usually expensive, being two to four times higher than mineral oil type soluble oils. Like all detergents, transparent soluble oils have excellent cleansing or washing ability. Hence, there is a possibility that they will wash away lubricating oils on moving surfaces, thereby causing sticking of such surfaces.

For this reason, the use of transparent soluble oils is normally confined to certain types of grinding operations or to machine tools on which there is no danger of the soluble oil washing out the lubricating oil from the moving surfaces of the machine.

In general, synthetic soluble oils are more sensitive to water hardness than the ordinary soluble oil. With some of the former, in fact, it is necessary to use water conditioners in order to assure ease of mixing with the water, obtain stable emulsions, and secure protection of the parts against rusting. Like all soluble oils, depending upon the type used, the rust-protective property of transparent emulsions may range from poor to good.

Oils for Machining Aluminum and Magnesium

In the great majority of cases, machining operations on aluminum and magnesium, including grinding, are performed with the use of a specially compounded light mineral oil, which replaces the kerosene-lard oil mixtures formerly employed as a cutting fluid.

The base oil used in most instances in preparing an aluminum or magnesium cutting fluid is of a paraffin type, well refined, and selected so that the viscosity of the resultant product will be in the vicinity of 40 to 60 seconds Saybolt Universal at 100 degrees F. Such oils, by nature, are light colored and are transparent.

* * *

Variable Scale Saves Time and Reduces Errors

A unique type of scale with an unusually wide range has been developed by the Gerber Scientific Instrument Co., Hartford, Conn. It is known as the Gerber "variable scale," and is related more closely to the standard engineer's scale than to a slide-rule, although it replaces both in some operations.

It consists of a conventional scale *B*, a slide *A*, and a variable scale *C*, which is a triangular 100-coil spring. Every tenth coil of the spring is marked in red, and the half-way coils between the red ones green. The fiftieth coil has a yellow dot. In use, when the slide is set on the conventional scale to any given dimension, that dimension can be divided into tenths, twentieths, or hundredths by merely reading the corresponding figure on the variable scale. For example, if a drawing is available, the scale of which is unknown, and which might lie between the 40 or 50 scale on the conventional triangular engineers' scale, the fixed scale is set to a known dimension and the actual dimensions on all other parts of the drawing can be read on the variable scale.

Dividing of odd dimensions is accomplished directly by the use of this scale, as is the reading of dimensions from curves based on an odd scale. Odd-scale drawing reproduction, calibrating of instruments, reading of trigonometric functions and derivatives, vector addition, analysis of indicator cards, conversion of units, and many similar problems can be solved by use of this scale.

* * *

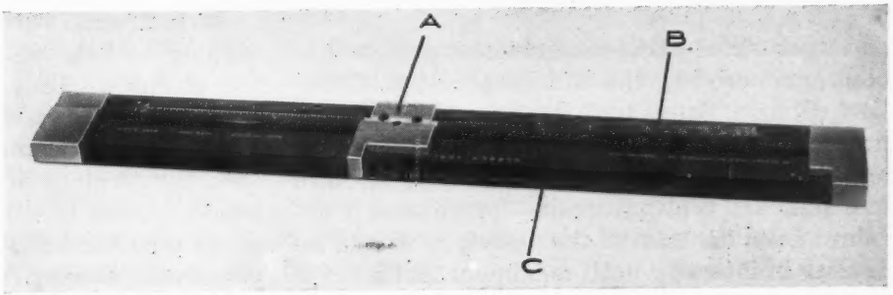
Standards for Inspection of Fine-Pitch Gears

The American Standards Association has announced approval of a standard for the inspection of fine-pitch gears, B6.11-1951, covering general gears; spur and helical gears; worms and worm-gears; bevel gears; backlash in gears; comparator lay-outs; gear blanks for fine-pitch gears; pin measurements; fine-pitch master gears; and surface roughness of gears. Fine-pitch gears are defined as gears of 20 diametral pitch and finer.

Two standards for inspection of fine-pitch gears were developed by the American Gear Manufacturers Association during World War II in answer to the urgent need for this material. Fine-pitch gears are essential in the manufacture of computing devices, fire control instruments, small automatic mechanisms, and other precision instruments.

The new American Standard is based on a combination of the AGMA standards. However, a completely new section on surface roughness requirements for gears has been included. The recommended maximum roughness height values range from 1/2 to 1000 micro-inches, and the recommended maximum waviness height values from 0.00002 to 0.020 inches. Also included in this new section are definitions; specification of roughness width, waviness width, height of roughness and waviness, and lay; measurements or evaluation of roughness; surface symbols; symbols indicating direction of lay; and symbols indicating gear tooth zone.

Copies of the American Standard for Inspection of Fine-Pitch Gears, B6.11-1951, are available from the American Standards Association, 70 E. 45th St., New York 17, N. Y.



Gerber variable scale is a new instrument designed for use in solving technical problems, such as those involving spacing, scaling, proportions, graphical algebraic calculations, plotting, etc.

Materials OF INDUSTRY

The Properties and New Applications of Materials Used in the Mechanical Industries

Water Soluble Transparent Cutting Fluid with High Film Strength

A water soluble transparent cutting fluid has been placed on the market by Lubricants, Inc., Detroit, Mich., under the trade name of "Tuff-Kut." The new cutting fluid contains no oil, neither vegetable nor hydro-carbon. It is transparent, smokeless, odorless, and provides protection against rust on machine parts. High film strength, low viscosity, and ability to dissipate heat make it applicable to such operations as drilling, milling, tapping, threading, sawing, etc. 1

Highly Finished Steel Tubing for Hydraulic Cylinders

Steel tubing suitable for use in making hydraulic cylinders, shock absorbers, and other applications has been placed on the market by the Tube Reducing Corporation, Wallington, N. J., in bore sizes ranging from 1 1/2 to 6 inches, depending on the wall thickness. Finished by cold-sizing, the tubing is free from scratches, pits, and other irregularities, the surfaces being smooth enough to be used with leather or other soft packing without any prior machining. When employed with metal piston-rings, the tubing does not require boring, but may be lightly honed. 2

Nickel Brightening Process Increases Luster of Plated Metals

A new nickel-plating brightener process has been announced by the Gill Corporation, Cleveland, Ohio. "Smoothex" brightener process, as it is called, makes use of the organic additive agents Smoothex No. 400, No. 50, and No. 200 in a standard Watts formula. Brightness is obtained from the start of the plating cycle and increases in intensity until maximum brilliance is reached. Polishing wheel marks or other flaws on the surface are said to be completely removed.

This method of nickel-plating is applicable to buffed brass, steel, and copper, unpolished cold-rolled steel, and die-castings after conventional copper cyanide plating. 3

Chromate Coating Process for Zinc and Cadmium

Enthone, Inc., New Haven, Conn., has announced the development of a process called "Enthox" for producing chromate coatings on zinc and cadmium plate and zinc-base alloys. The process, which is operated at room temperature, uses from 1 to 2 ounces of salt per gallon of water. It is said that after a few seconds' immersion, an adherent chromate coating is produced on the piece to be coated. Enthox coatings serve as bases for organic finishes, including paints, enamels, and lacquers. They can be dyed various colors, including jet black and red..... 4

Compound for Removing Scale from Forgings

A compound for removing furnace scale during quenching in the production of heat-treated steel forgings is now being marketed by the Pennsylvania Salt Mfg. Co., Philadelphia, Pa. The pre-heat chemical bath is made up by dissolving Pennsalt SR-4 in weak muriatic acid and water. This bath requires no heating and can be used in ordinary rubber-lined tanks.

Parts covered with forging scale are placed in dipping baskets and immersed in the bath for five minutes. They are then either placed directly in heat-treating furnaces or stored for later heat-treatment. In the heat-treating process, the forgings are heated for the prescribed length of time in either a non-reducing or a prepared atmosphere. After heating they are water quenched. During this quenching operation, the

To obtain additional information on materials described here, use Inquiry Card on page 229.

furnace scale is removed from all surfaces of the parts, leaving them clean for subsequent machining operations. Should the parts require oil quenching, scale removal may not be complete and sand- or shot-blasting operations would have to be utilized for final descaling.

Baths of this kind are being used in the descaling of plain carbon steel grades and some S A E alloy steels.....5

"Powerfilm"– New Rust-Preventive Coating for Metals

"Powerfilm"—a rust- and corrosion-preventive coating—has been introduced on the market by the Thomas Co., Chemical Coatings Division, Minneapolis 3, Minn. It may be brushed, sprayed, or wiped on any metal surface, and when dry, forms a non-oily, non-toxic protective film that will not crack or chip. The compound thins down when stirred or brushed, but thickens on standing. It can be used to protect all weather-exposed machinery and tools, and is readily removed by the use of naphtha. 6

Quick Drying Rust Inhibiting Metal Primer

A fast drying, penetrating metal primer has been added to the "Totrust" line of rust preventives. This primer prevents peeling, chipping, and rusting, and enables recoating to be done in from ten to thirty minutes with all standard types of paint, as well as rubber-base paints, vinyl coatings, and spraying lacquers. It is a product of the Wilbur & Williams Co., Boston (Brighton), Mass. 7

Organic Cutting Fluid for Machining and Cold-Drawing Operations

The availability of "Cut-Cool," an organic cutting fluid for use in general machining and cold-drawing operations, has been announced by the Organic Products Co., Irving, Tex. This cutting fluid can be used in low concentrations.

It is readily emulsifiable in soft or hard water, stable, and forms a very thin but adherent film on metals, which gives tool lubrication and imparts corrosion resistance. This thin film insures low "drag-out" losses, and can be removed from the metal by the use of an alkali wash. The emulsion will not become rancid. Concentrations of 5 per cent can be used for drilling, milling, and cold-drawing, and a 2 per cent concentration can be used for wet grinding. 8

Silver Solder Having High Corrosion Resistance

Excellent corrosion resistance and an unusually narrow plastic range characterize a silver solder recently brought out by the All-State Welding Alloys Co., Inc., White Plains, N. Y. This No. 155 Premium silver brazing rod contains 55 per cent silver, has a working temperature of 1155 degrees F., and develops a tensile strength of 50,000 pounds per square inch. It is applied by torch or furnace methods, using No. 100 or 200 Brazaloy flux for copper and copper bearing alloys, and No. 100 Brazaloy flux for ferrous alloys. 9

Odorless Emulsion for Cleaning and Degreasing

Aviation-Industrial Chemicals Division of Fine Organics, Inc., New York City, has brought out a solvent emulsion cleaner, known as FO-106, for industrial use. This is a concentrate, intended to be diluted with kerosene or Stoddard solvent in proportions from four to nine parts of the solvent to one part of compound. It is applied to the metal or painted surfaces by brush or spray in a diluted form, and then rinsed off with cold or hot water. Dirt and grease are emulsified and carried off in the rinse. For wiping off production machines, a 1 to 9 solution can be used without rinsing. This cleaner is not harmful to the skin.....10

Powder that Provides Protective Gas Atmosphere in Heating Metals

Protective atmospheres of hydrogen, carbon monoxide, and nitrogen, suitable for use in non-generator equipped furnaces and induction and resistance heaters to prevent bluing, scaling, and decarburization of steel, brass, and copper parts are provided by a powder that decomposes into these gases on heating. This product is marketed under the name "Atmosand" by the Marlyn Chemical Co., Calumet City, Ill. It will permit bright heat-treating, annealing, or copper brazing in a furnace devoid of gas-generating equipment.

Other possible uses include the formation of a temporary atmosphere for copper brazing and scale reduction during the heating cycle in induction and resistance heating units, and for nitriding in the event of a breakdown or failure of the gas-generating equipment. The powder is said to be non-toxic, non-inflammable, and free-flowing.....11

To obtain additional information on materials described here, use Inquiry Card on page 229.

Plowshares Welded One a Minute by the Use of a Rotary Fixture

The eight-piece rotary fixture illustrated has enabled the production of welded plowshares to be increased by 10 per cent at the Allis Chalmers plant in LaCrosse, Wis. The fixture holds the parts in position, and moves them under a Unionmelt welding heat at the proper speed. In the operation, two parts of the plow—a die-cut gunnel and a forged share—are welded together. These parts are inserted into the fixture by the operator and secured in place by air clamps. The edge of the share meets the gunnel at an angle of 22 degrees, and thus provides a welding vee. A copper bar backs up the joint, so that a fully penetrated edge weld can be made.

As the table moves the assemblies beneath the welding head, granulated Unionmelt composition covers the welding zone. The weld is started at the precise moment when the edge of the assembly passes beneath the welding rod by a momentary discharge of high-frequency power, which provides a path to initiate the flow of the welding current.

With the welding action established, the voltage control automatically governs further operation. A portion of the granulated composition fuses in the welding zone, excludes the air from the weld, and conducts the current from the rod to the work-piece. Welding takes place without flash, glare, or spatter. For this application, 35-volt, 500-ampere, alternating current is employed. The welds are made at the rate of 19.1 inches per minute.

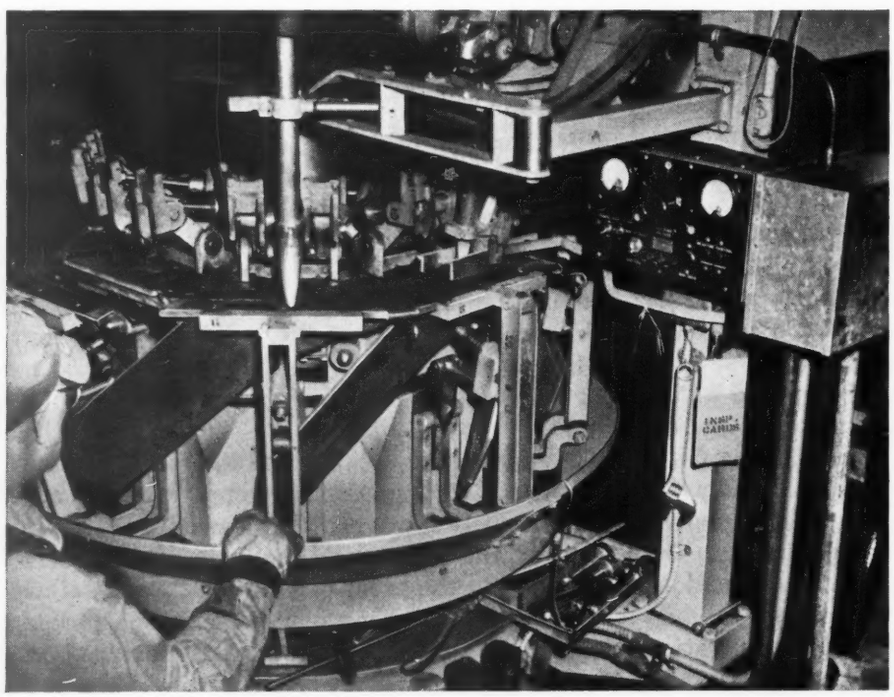
As the share moves past the welding head, a vacuum unit recovers the unfused welding composition and returns it to the hopper. A second operator then removes the welded shares from the fixture. If the fused welding composition were allowed to cool completely, it would snap off by itself. In this high-speed fixture, the fused composition cools sufficiently so that a little tap with a hammer causes it to drop off. This reveals the weld, which is dense and so smooth and clean that no chipping or grinding is required.

One fundamental problem in the design of this fixture was caused by the fact that the share moves in a circle beneath the welding head, while the joint to be welded is a straight line. The fixture had to be designed to move the welding head also, so that the combined motions would result in a straight-line weld. The problem was solved by using an eight-faced cam which causes the welding head to swing in and out; this motion, combined with the circular motion of the table, produces the desired result.

With one man to load the fixture and another to unload it, production of the machine averages from sixty to sixty-five completely welded plowshares per hour. In addition, the machine-welded plowshares are strong, long wearing, and well fitting.

* * *

About $1,700,000,000 will be the cost of expansion and improvement in the steel industry in 1950 and 1951. It is planned to spend $1,200,000,000 this year, a record high amount.



Plowshares are welded automatically with Unionmelt equipment as they pass beneath the welding head of a rotary fixture

TOOL ENGINEERING *Ideas*

Tools and Fixtures of Unusual Design and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

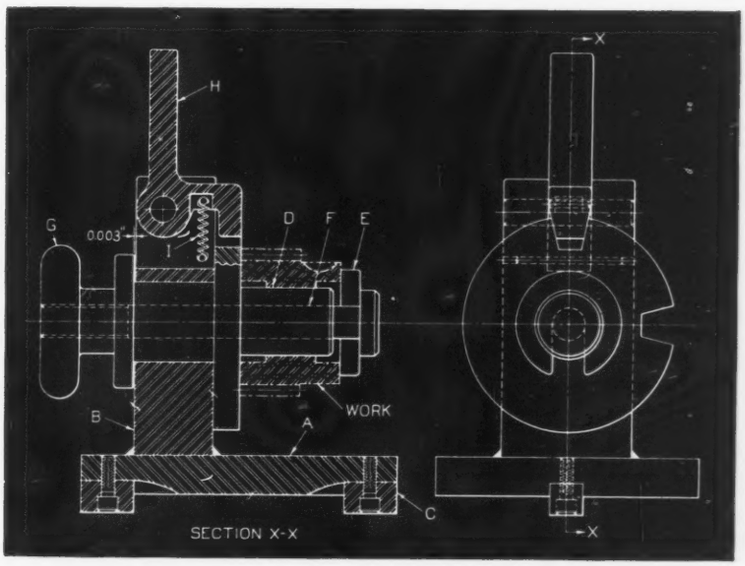
Quick-Acting Milling Fixture

By IRVING MANSFIELD

The milling fixture illustrated is an example of low-cost construction; yet it is fast acting and will turn out accurate interchangeable pieces. In addition, it is rigid and positive. The work to be milled is a transmission sliding gear used in self-propelled harvesting machinery. It is made of S A E 1020 steel, and two Woodruff keyslots are to be milled in it, 90 degrees apart.

Base *A* and upright *B* are welded together. Two slots are milled in base *A* to receive keys *C*, which align the fixture on the milling machine table. Arbor *D* is made in one piece and serves as an indexing plate as well as the work locator. In operation, a C-washer *E* is slipped between the work and the draw-bolt *F*. By tightening hand-knob *G*, the work is clamped securely in place, but this does not prevent it from rotating. A slot is milled through upright *B* for a slip fit with an indexing handle *H*, which is pinned in place and held in position by a tension spring *I*. Arbor *D* has two notches 90 degrees apart in it for locating handle *H* when milling either keyway. The back end of arbor *D* is made about 0.003 inch longer than the thickness of upright *B*. This allows the work to revolve freely when handle *H* is pushed back. Arbor *D* and handle *H* are hardened to prevent wear.

It can readily be seen that while the fixture is not complicated in design, it has the advantages of a high-production tool at minimum cost.



Low-cost milling fixture designed for machining two Woodruff keyways, 90 degrees apart, in transmission sliding gears

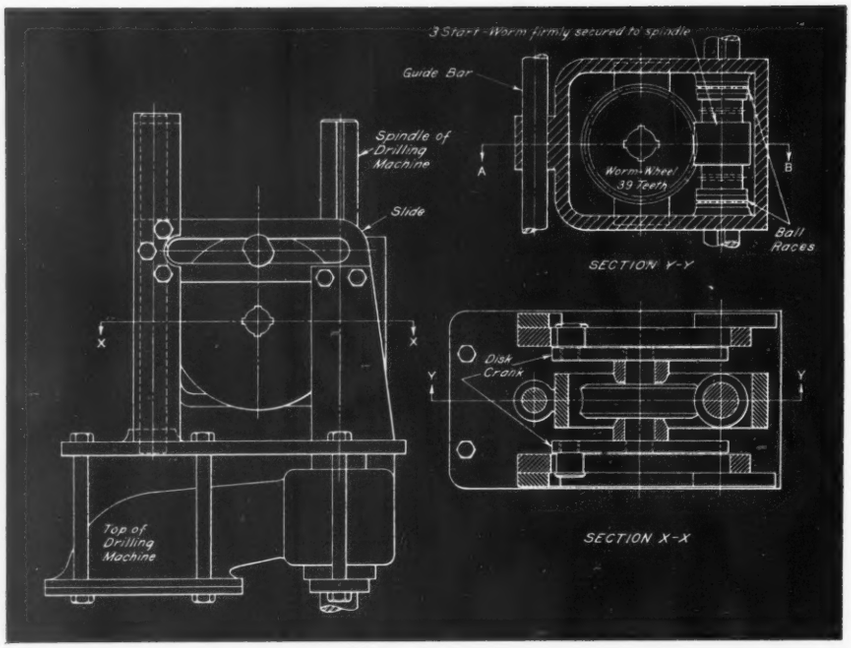
---

Attachment that Adapts a Drilling Machine for Lapping

By GERHARD WENKE, Los Angeles, Calif.

The mechanism illustrated (see next page) was designed to impart an automatic reciprocating movement to the spindle of a drilling machine, so that the machine could be used for lapping operations. This attachment was originally applied to an old type of drilling machine, but with a few alterations it can be adapted to suit any type.

A worm, keyed to the revolving spindle, drives a worm-wheel on the shaft of a disc crank. Pins in the disc crank slide in guides that are firmly attached to the machine body. As a result, the pins can only move horizontally. This horizontal movement forces the disc crank slide and the



Drill press attachment employed to impart a vertical reciprocating movement to the spindle for performing lapping operations

gear into a vertical reciprocating movement. The slide, in turn, transmits this movement to the drill spindle, so that it moves up and down. The friction is taken up by ball bearings on each side of the worm. The slide is kept from revolving with the spindle by a guide bar, which is secured to the baseplate.

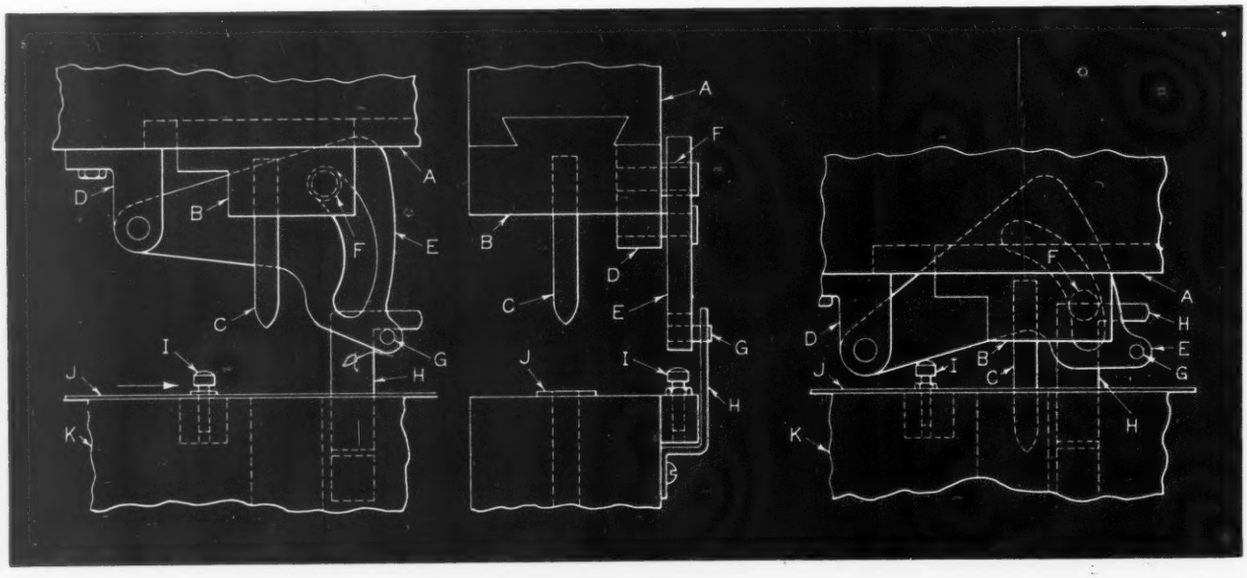
The ratio between the worm and worm-wheel is 1 to 13 in this case, resulting in 6 1/2 revolutions per stroke. The length of the stroke is about 5 inches. Provision for adjusting the length of stroke can be incorporated in the design if desired. To apply this attachment to a drill press, the pinion meshing with the rack of the spindle has to be removed, after which the whole structure is securely fastened to the machine body.

Punch Press Feed Increased by the Use of a Sliding Pilot

By L. KASPER, Philadelphia, Pa.

The unique arrangement of the sliding pilot shown at *C* in the accompanying illustration was employed on an automatic punch press to obtain a longer feed than that available with the regular press equipment. For clarity, the stripper plate and guides have been eliminated in all three views of the illustration.

Referring to the front view, it can be seen that stock *J* passes over the die in the direction indicated by the arrow. The block *B* in which the pilot *C* is mounted is a sliding fit in a dovetail



Arrangement devised to increase the normal maximum stock feed on a punch press

slot in punch-holder *A*. Roller *F* at the back of block *B*, rides in the cam-slot in lever *E*, which is free to swing on a stud on the bracket *D*. Screw *I* is fastened to a block at the back of the die *K* to actuate lever *E*.

When the regular feed of the press has advanced the stock the normal maximum amount, it brings a pierced hole in the strip directly under the pilot. Pilot *C* then begins the movement which provides the additional feed required. As the ram descends, the pilot enters the hole in the stock and the under side of the cam-lever *E* contacts the screw *I*. Continued downward movement of the ram causes lever *E* to swing on its stud, so that roller *F* moves downward in the cam groove. This results in moving block *B* to the right, and since pilot *C* is engaged in the hole in the strip stock, the latter is also moved to the right, bringing it to the next piercing station, as shown in the right-hand view of this assembly.

As the remainder of the cam groove is a true arc on the center of rotation, there is no further movement of pilot *C* and the material *J* remains stationary during the piercing operation. On the return stroke, pin *G* contacts stop *H*, so that the cam action of lever *E* returns pilot *C* to its initial position ready for the next stroke.

Cutters Designed for Machining Seats and Grooves in Air-Valve Parts

By ROBERT W. NEWTON, Tool Engineer
International Business Machines Corporation
Poughkeepsie, N. Y.

The manufacture of parts for compressed air valves involves the machining of many accurately positioned seats on the ends of bushings and valves. These seats must be at right angles with the bushings. They must also be smooth to insure an air-tight fit. One of the check valves or bushings for an air valve is shown in the view to the left in Fig. 1. The spiral cutter that was designed to machine the seats on this bushing at *A* and *B* is shown to the right. The two seats are identical except for the diameters of the counterbored holes. This made it necessary to use two cutters, one for each seat.

The cutter shown in Fig. 1 is made of high-speed steel. The shank is machined to a slip fit for a hole in the turret of a screw machine. A flat for a set-screw is machined on the side of the shank. If the cutter is to be used on a drill press, it should be made with a Morse taper shank. In this case, a pilot will be necessary in in order to maintain accuracy. A hole is drilled

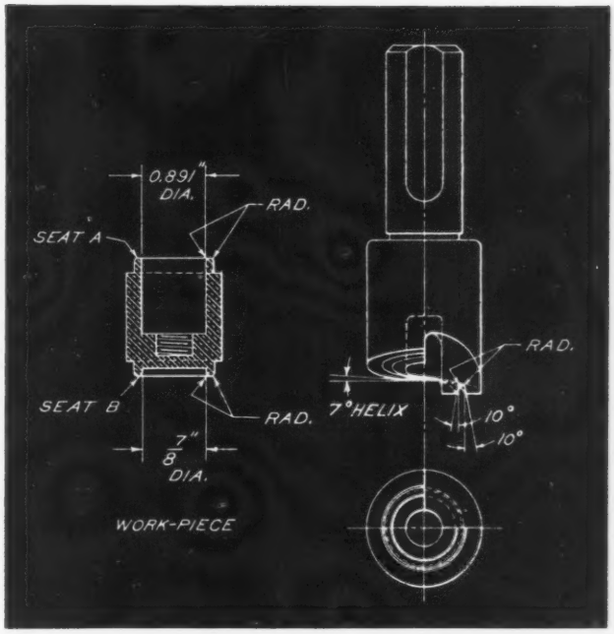


Fig. 1. Air-valve bushing with seats at (A) and (B) machined by special spiral cutter shown in view at right

in the other end of the cutter to a depth somewhat greater than the length of the milled out quarter section. The spiral in the cutter is milled to a helix angle of approximately 7 degrees.

The tool shown at *A* in Fig. 2 was designed for machining the desired form on the helical face of the cutter illustrated in Fig. 1. Tool *A* is made of high-speed steel and hardened. Its end is ground to a width equal to the wall thickness of the valve to be seated and with the desired radii at the corners. The sides of this forming tool are chamfered to an angle of 10 degrees, so that the radii of the seat will blend with the in-

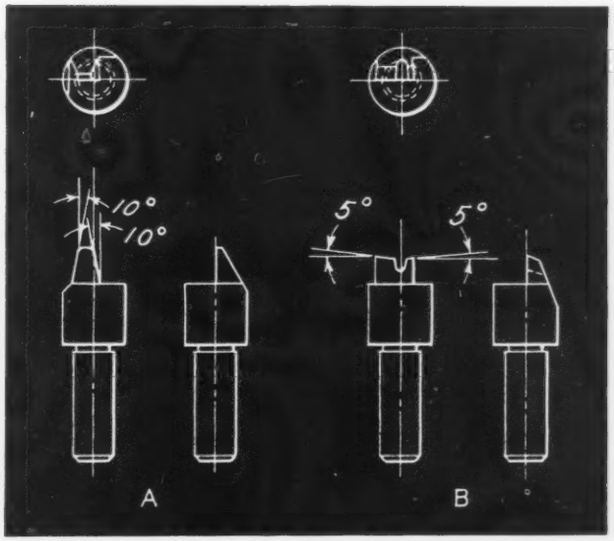


Fig. 2. (A) Tool employed for milling formed helical face of cutter shown in view at right, Fig. 1. (B) Forming tool made for milling formed trepanning cutter illustrated in Fig. 3

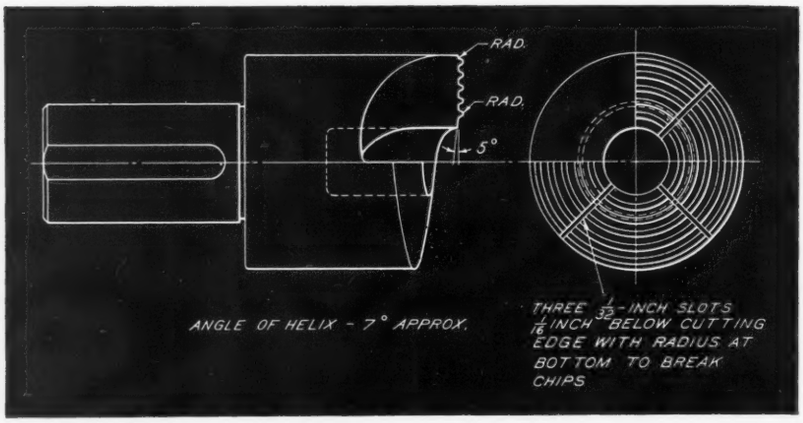


Fig. 3. Trepanning spiral type cutter designed for machining five annular grooves in valve body seen in Fig. 4

side and outside diameters of the valve. The tool is then backed off, so that it will cut. After being ground, the form tool is checked for accuracy. Then it is ready to be used for milling the spiral seating cutter to the desired form, shown diagrammatically in Fig. 1.

After the formed seating cutter face is machined, a quarter-section is milled out to a depth somewhat greater than the height of the spiral. This provides the cutting edge. The cutter is then hardened, and the seat form is polished. Only the shank is ground. When it becomes worn, this cutter can be sharpened by grinding the face of the cutting edge.

In Fig. 3 is shown another spiral cutter that was made to trepan five annular grooves in the face of a valve body. The plan view of the valve body and an enlarged section view *Z-Z* showing the form of the annular grooves are illustrated in Fig. 4. The elements of design and the processes of manufacturing the trepanning cutter are essentially the same as those described for the cutter illustrated in Fig. 1. Since quite a lot of metal is removed with the cutter shown in Fig. 3, it is made with three chip-breaker slots machined across the spiral face.

The forming tool made for milling the desired form on the trepanning type cutter is shown at *B*, Fig. 2. This tool contains the form for only one of the five nubs required on the trepanning

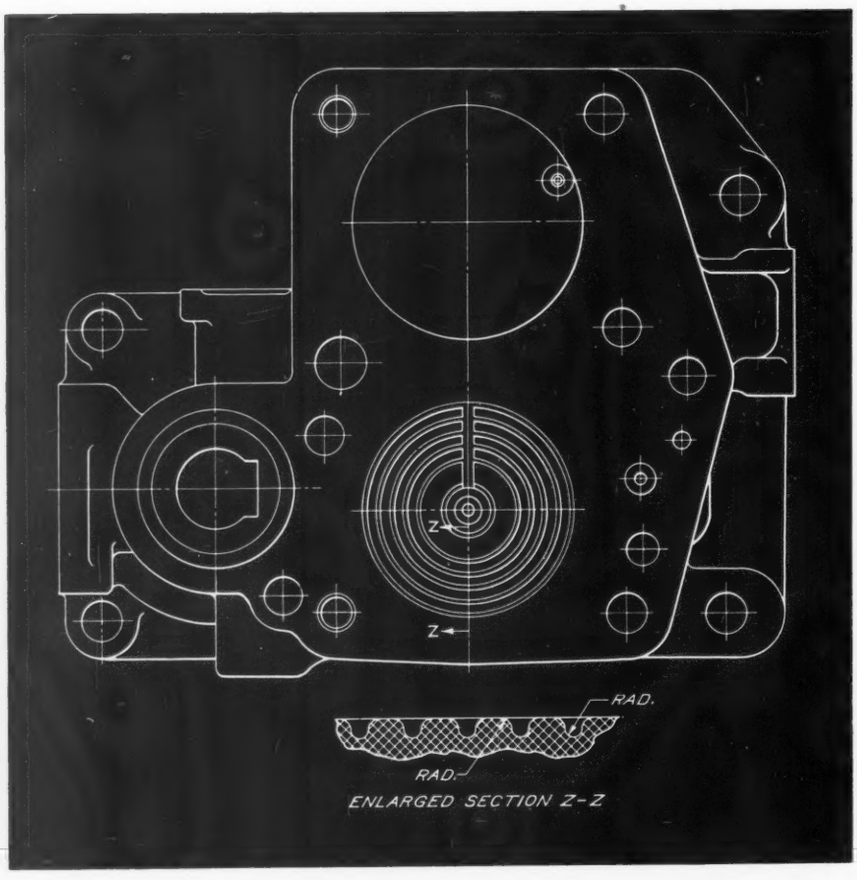


Fig. 4. Air-valve body with annular grooved seat machined by trepanning tool shown in Fig. 3

cutter. The faces of the two side radii are ground at an angle of 5 degrees, so that the trepanned grooves will blend with the face of the casting. After the form for one of the nubs is milled on the cutter, the milling machine table is moved the required distance and the next nub is milled. This process is repeated until all of the desired form has been milled on the trepanning cutter.

The original cost of a cutter of this type is rather high, as it is necessary to make a tool for milling the desired form in the cutter. However, this cost is negligible when the long life of the cutter is considered.

Portable Hopper Type Container Facilitates Assembly of Balls

By W. M. HALLIDAY, Birkdale, Southport, England

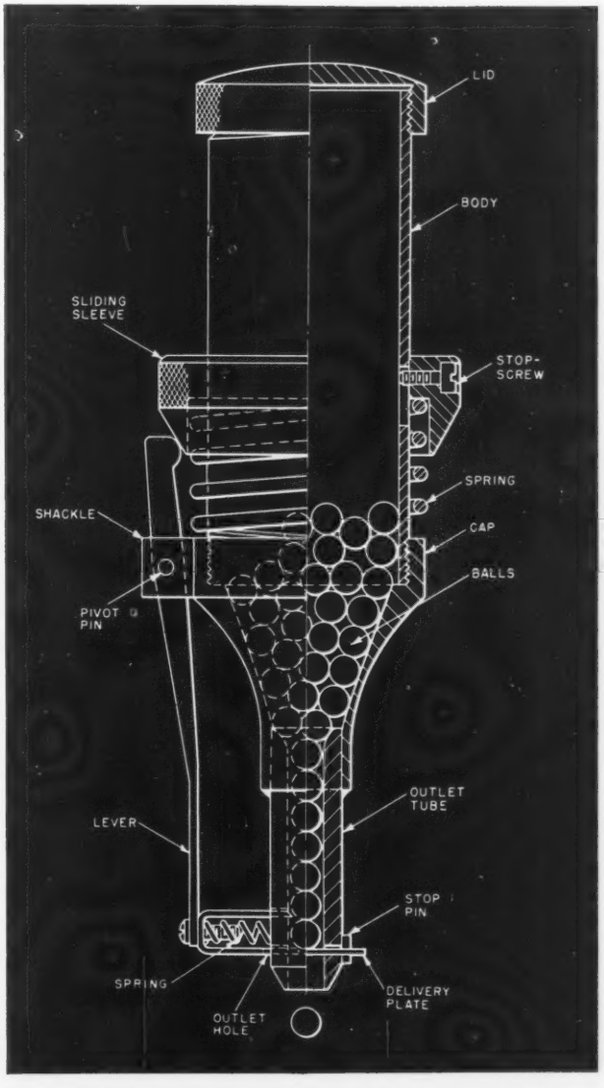
The portable hopper type container shown in the illustration was designed to simplify and expedite the assembly of a number of balls into individual housings. Such a time saving device is especially advantageous when each ball must be succesively deposited in a given location in assemblies such as bearings, lubricators, timing mechanisms, etc. Slow, tedious sorting and picking up of each ball from a tray or other container and inserting the balls manually into their correct positions are eliminated.

A large quantity of balls may be loaded into the hand-operated hopper container at the beginning of the assembly operation. Only one ball will be ejected onto the work-piece each time the device is actuated, regardless of the speed or pressure with which it is operated. Also, balls cannot be ejected when the container is in the closed position shown. It automatically returns to this closed position upon the removal of hand pressure.

The main body of the hopper container is a cylindrical tube that is externally threaded at both the upper and lower ends. A lid, screwed to the top of the body, is removed when additional balls are to be added. A funnel-shaped cap is screwed to the bottom of the body. The lower end of this cap is bored to accommodate the outlet tube, which is soldered or brazed to the cap. The bore of the outlet tube is approximately 1/32 inch larger in diameter than the balls, and is well rounded at its upper end to facilitate entry of the balls into the tube. A sharp-angle chamfer is machined on the periphery of the tube at its lower end so that the tool can be introduced into confined spaces.

Fitted at right angles to the longitudinal axis of the tube, and located near its lower end, is a U-shaped delivery plate. The plate, which is about 1/8 inch wider than the diameter of the balls, is free to slide in slots provided in the wall of the tube. Two diametrically opposite slots are provided for the lower, longer leg of the plate, and a single slot of the same dimensions permits entry of the upper leg into one wall of the tube. The vertical distance between the two parallel legs is made slightly greater than the diameter of the balls. An outlet hole for the balls is drilled through the lower leg, the hole being so located that it is not within the tube bore when a stop pin (that has been pressed into a hole near the outer end of the lower leg) is in contact with the periphery of the tube. In this "closed" position, the beveled edge of the upper leg projects slightly within the tube bore.

Interposed between the closed end of the U-shaped plate and the tube is a light compression spring that encircles a screw connecting the plate to a vertical lever. This lever passes through an



Portable hopper type container which ejects one ball at a time when the sliding sleeve is pressed downward

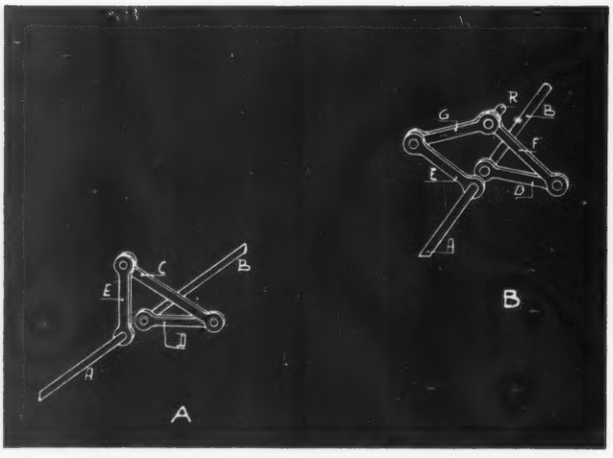
open-end slot in a shackle connected to the upper rim of the cap, and is pivoted on a pin pressed into the shackle. The upper end of the lever is provided with a cam surface contacting the conical nose of a sleeve that slides on the periphery of the tubular body. Vertical movement of the sliding sleeve is limited by a stop-screw that projects into an elongated, vertical slot cut in the wall of the body. The sleeve is normally held in its uppermost position, as shown, by a vertical spring resting on top of the cap.

In operation, when the sliding sleeve is pushed downward by hand, the lever will be swiveled counter-clockwise and the delivery plate will be slid to the right. Movement of the plate in this direction is halted—with the outlet hole in the lower leg of the plate aligned concentrically with the outlet tube bore—when the tip of the screw connecting the lever to the plate contacts the periphery of the tube. Only one ball will drop from the bottom of the tube because the upper leg of the delivery plate has passed between the first and second balls in the vertical column.

When hand pressure is removed from the sleeve, the two springs return the plate, lever, and sleeve to their original (closed) positions. The vertical column of balls will drop, with the next ball to be released resting upon the bottom leg of the delivery plate, ready for the next cycle. By making the lid, body, cap, and sleeve of aluminum, the hopper container will be quite light, so that it can easily be operated by one hand.

The device can be adapted to deliver two or more balls per cycle by simply modifying the delivery plate to increase the vertical distance between its legs. Another possible modification is to provide a narrow vertical slot in the wall of the tubular body so that the remaining stock of balls can be quickly observed.

Fig. 1. (Below) With a link (C) connecting shafts (A) and (B), which are in axial alignment, the shafts will move together as a rigid system. Replacing (C) by two links (F) and (G), as shown at (B) permits a difference in the relative speeds of the shafts



Producing Variable Speed from Constant Rotary Motion

By J. J. POT, Slikkerveer, Netherlands

The mechanism shown on page 187 of November, 1950, MACHINERY, will not accelerate the speed of shaft *A* as described when driven by the constant-speed shaft *B* with which it is in axial alignment. This is because the rolling pinion *J* (see illustration accompanying article) remains in engagement with both gears *F* and *G*, and as a result, shafts *A* and *B* cannot change their positions relative to each other. Despite the action of cam *I*, shaft *A* will move at exactly the same speed as shaft *B*.

To transmit a varying or alternately accelerating and decelerating speed to shaft *A*, some such mechanism as here illustrated would be necessary. As shown in Fig. 1 at *A*, there is a crank *D* on shaft *B* and a crank *E* on shaft *A*. If the two cranks are connected with a link *C*, shaft *A* will rotate with *B* as a rigid system. However, if link *C* is replaced by two links *F* and *G*, as shown in view *B*, the rotating speed of shaft *A* can be accelerated or decelerated by expansion or contraction of links *F* and *G*. Cam follower *R*, which serves as a journal for links *F* and *G*, governs the acceleration or retardation of one shaft with respect to the other. Cam *I* does not rotate, but is fixed on one of the bearing brackets of shaft *A* or *B*. A better arrangement would be to use two cams, one on each of the bearing brackets, as shown in Fig. 2.

With the mechanism illustrated in the accompanying diagrams, it will be obvious that the acceleration of the driven shaft must be followed by an equal amount of deceleration during the same revolution.

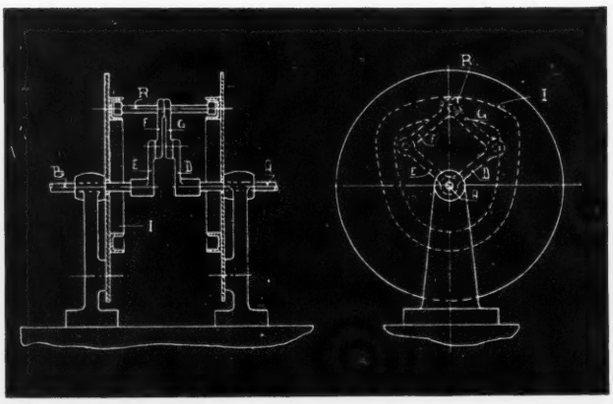


Fig. 2. (Above) The cam follower (R), which serves as a journal for links (F) and (G), governs the acceleration or deceleration of shafts (A) and (B) relative to each other. The cam does not rotate, but is fixed on the bearing brackets of both shafts

Ideas for Shop and Drafting-Room

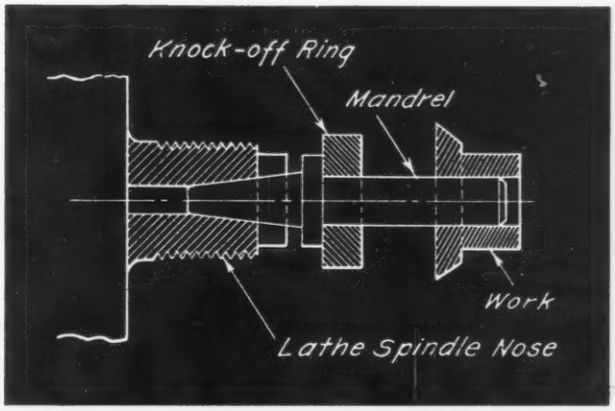
Device For Locking Index-Plate In Any Desired Position

By FRITZ L. KELLER, Bloomfield, N. J.

While accurate and positive means are provided on milling machine dividing heads for locking the index-plate in various angular positions, it is sometimes desirable to lock the plate in intermediate locations. Although this can be accomplished by parallel clamps or other makeshift methods, the simple, inexpensive friction type device illustrated has been found to be a most efficient and convenient means of locking the plate in any desired position.

The clamping device contains a special cover, which replaces the standard gear-box cover on the dividing head and is secured to the gear-box by the same two screws that hold the standard cover in place. A flange on the special cover is equal in thickness to the space between the index-plate and gear-box. The cover is slotted across its center to fit a spring-loaded clamping strap. A locking screw holds the strap against the cover, and the index-plate can be secured in the desired position by simply tightening the screw.

Care must be taken to insure that the outer circle of holes in the index-plate is not obstructed by the strap, and sufficient clearance must be provided to permit the index plunger to be engaged without interference. Also, the sector arms must be shortened to allow them to be moved freely past the clamping strap. When changing index-plates, the screw, strap, and spring must be removed and then replaced.



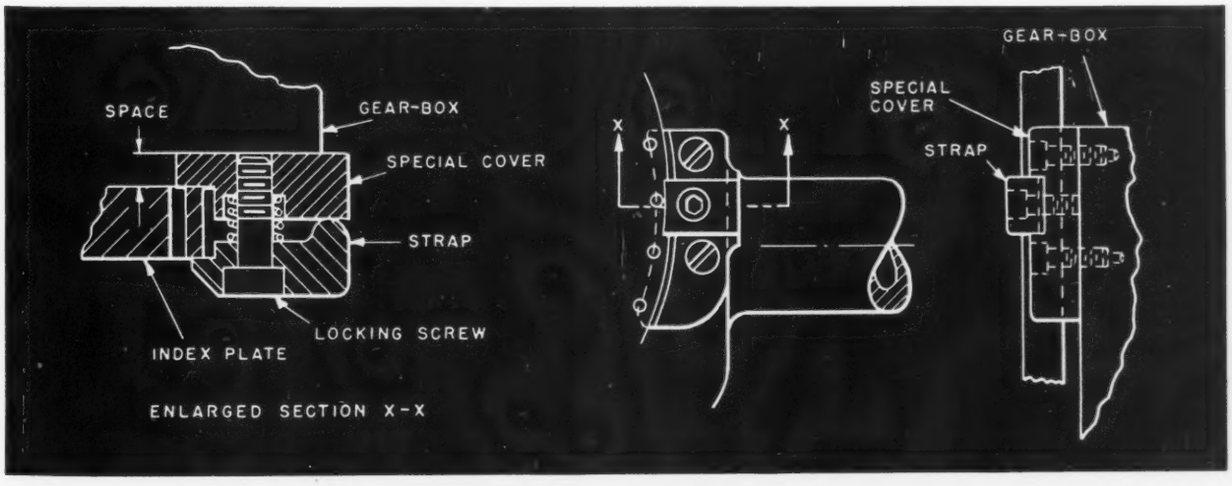
Knock-off ring permits easy removal of work from a mandrel following a machining operation

Knock-Off Ring Facilitates Removal of Work from Mandrel

By JAMES J. BAULE, Brooklyn, N. Y.

A handy device for removing work from a mandrel is shown in the illustration. Such an arrangement is particularly useful for second-operation lathe work when substantial quantities of parts must be machined. Considerable time can be saved because an arbor press is not required for removing the work.

The mandrel is provided with a tapered end to fit the hole in the live spindle of the lathe and secured by some positive means. The bore of the knock-off ring is slightly larger in diameter than the mandrel, so that the ring can easily be slid along the mandrel. After being machined, the work is struck with the ring until it is forced off the mandrel.



Friction type clamping device employed to lock the index-plate of a milling machine dividing head in any desired angular location

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester and Silver
Sales Management Engineers
New York and Philadelphia

Written Words—The Engineering Report

"I'D much rather talk than write it down. Guess I'm no scribe." This statement is typical of most equipment salesmen. We can commonly express thoughts better by the voice than by the written word.

In our business, most written reports are "what *must* be read" rather than "what the prospect *chooses* to read." So anything we can do to make our writing easy to grasp—less tedious and dull—redounds to our benefit.

The written report is not usually directed to one person only. It is passed from one to another in the prospect's organization. It is our dummy representative, and yet can be made our salesman. It is constructive or destructive, depending on the facts it contains and the way we present them. It is evidence of our ability, and of that of our own concern.

How Do We Go about Preparing a Report?

Evaluate all the facts to see that they are accurate, complete, and necessary.

Arrange these facts in logical order.

Think of exactly what will attract and interest the prospect.

Spot those advantages that must be emphasized.

Decide what tabulated data or sketches are required.

What Should Be the Contents and Arrangement of a Report?

Recently in calling on a plant manager, I found him attempting to review a report of new equipment for his punch shop. Finally he pressed his secretary's buzzer. He handed it to her. "Tell Harry," he said, "to read this and tell me what it is all about. I haven't time to unravel it."

Any report of consequence should give a brief summary of the contents on the front page. Otherwise, the busy executive, not completely familiar with details, will get tired of wading through it and like as not will throw it aside. In general, reports should be made out along the following lines:

1. State the purpose of the report.
2. Outline the problem and conditions to be met.
3. Sketch the recommendations—technical and economic conclusions.
4. Itemize the advantages of the proposed solution.
5. Suggest possible alternatives.
6. Supply supporting technical data.
7. Present business data relating to time, cost, terms, and responsibilities.
8. Refer briefly to our various abilities to serve.

How Can Our Ideas be Best Expressed?

The following points are essential in writing a report that will be easily understood:

1. Be brief and clear. Get rid of all doubtful interpretation.
2. Avoid long sentences and paragraphs. Limit each paragraph to one central thought.
3. Choose simple and, if possible, short common words that can readily be understood.
4. Make positive statements—cut out unnecessary "if's, and's, and but's."
5. Slant every expression to carry an enthusiastic sales appeal.
6. In the less formal report—not a proposal—tuck in the inference of cooperative effort from the prospect's personnel as a diplomatic gesture.
7. Above all, make the report, by the use of captions, spacing, and wordage, easy to read.
8. Be absolutely sure to include supporting technical data, sketches, and blueprints in the

proper place. If these are extensive and must be placed at the end of the report, properly identify them in the text.

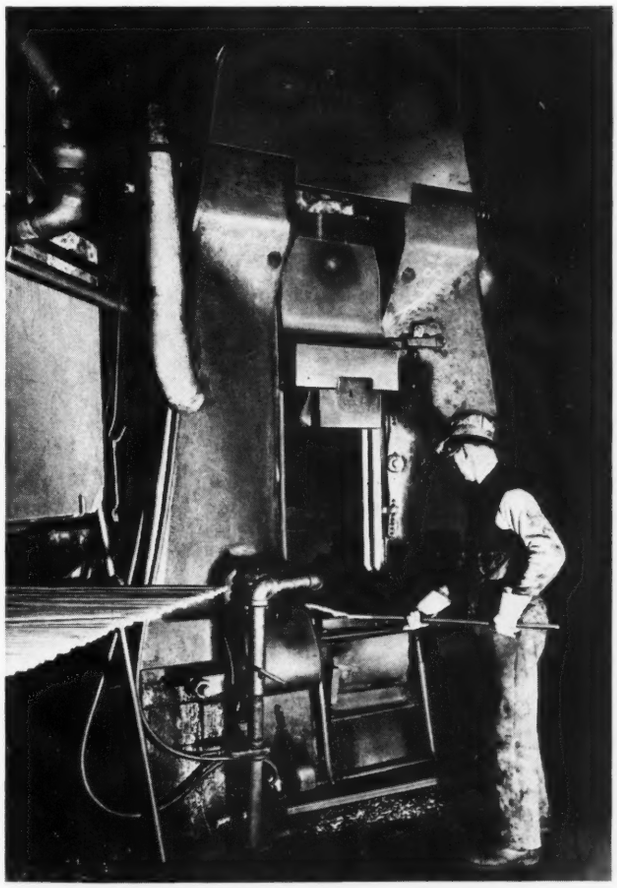
9. Make the report an example of neatness, and jacket it in workmanlike shape. Name it and indicate its source.

10. Make a sufficient number of clear, clean copies for the various persons involved.

In submitting a report, the best practice is to present it personally. This may offer a sales opportunity. In cases where it is necessary to mail the report, together with copies to certain individuals, include a letter—brief, of course—containing a selling message that is directed to the person interested.

* * *

An aluminum tube, 4 feet long and 7 inches in diameter, was dropped by parachute over Japan by the same airplane that dropped the atomic bomb on Nagasaki. The tube contained a message for Professor Ryokichi Sagane, a nuclear physicist, urging him to persuade the Japanese general staff to surrender.



This new 5000-pound air hammer will soon double the size of precision forgings made by Arcturus Mfg. Corporation of Venice, Calif. The drop-hammer, produced by Chambersburg Engineering Co., will be installed complete with trim press and furnaces

Operator using gauss meter to check the strength of the magnet in a Perma-Plate magnet unit

Gauss Meter Solves Problem of Controlling Magnet Strength

The strength of the magnet used in some types of magnetic separation equipment made by the Dings Magnetic Separator Co., Milwaukee, Wis., had to be controlled within close tolerances, especially where the strength of the magnet varied with each separate "run through" of the product. The correct control of magnetic strength was finally obtained through the use of a gauss meter, an instrument developed by the General Electric Co. to give a true reading regardless of its relation to the lines of force or its distance from the poles of the magnets.

* * *

Data Sheets on New Abbreviated Motion Times

Data sheets providing complete information for applying a new technique of motion-time work measurement to a wide range of manual tasks in job-lot industrial production have been published by the Work-Factor Co., 366 Madison Ave., New York 17, N. Y., management consultants.

The new abbreviated time standards can be rapidly applied to determine the approximate time required to perform any type of manual work. They are useful where accurate estimating of labor cost, in advance of actual production, is required quickly, or where it is desirable to determine incentive rates on small-quantity, nonrepetitive, or long-cycle operations. Single copies can be obtained from the publisher at $1.

LATEST DEVELOPMENTS IN *Shop*

"Red Ring" Gear-Shaving Machine Designed to Handle Large Ring Gears

The National Broach & Machine Co., Detroit, Mich., has developed a new large size "Red Ring" gear-shaving machine designed to handle both internal and external spur and helical gears with face widths up to 40 inches and pitch diameters up to 100 inches, such as are used in tanks, large speed reducers, stationary prime movers, etc. This machine operates on the rotary crossed-axes principle, with the work-gear driving the cutter, as is customary in shaving gears having pitch diameters larger than 24 inches.

The general design includes an independently driven rotary work-table and a column having horizontal power rapid traverse in both directions for moving the cutter-head to and from the work. The cutter-head reciprocates in a vertical slide, carrying the shaving cutter across the face of the work.

The gear to be shaved is clamped in a fixture with its axis in a vertical position. The fixture is mounted on the work-table, which is so designed that there are no projections above the surface to interfere with the handling or loading of heavy gears. The speed of the table is selective over a wide range by means of change-gears.

The column that carries the cutter-head assembly moves horizontally, and is supported throughout its full travel on hardened and ground slide ways in the machine base. The bearing pressure on these ways is approximately 15 pounds per square inch.

A safety electric control automatically stops the rapid advance of the column just short of engagement between the cutter and the work-gear. Engagement is accomplished by a handwheel, which is also used to feed the cutter into the work during the shaving operation. The rapid traverse in both directions is used to bring the cutter-head approximately into the cutting position and to withdraw it. A direct reading dial indicator on the column shows the operator the exact amount of each increment of in-feed and also when the work has been shaved to the specified size.

Driving power for the horizontal traverse movement of the column and the vertical movement of the cutter-head is supplied by a single motor. These movements are controlled through manually operated clutches, which are so interlocked that only one movement can be made at a time under power. The cutter-head slide is mounted on a rigid tilting mechanism, which can be adjusted to insure having the path of the re-

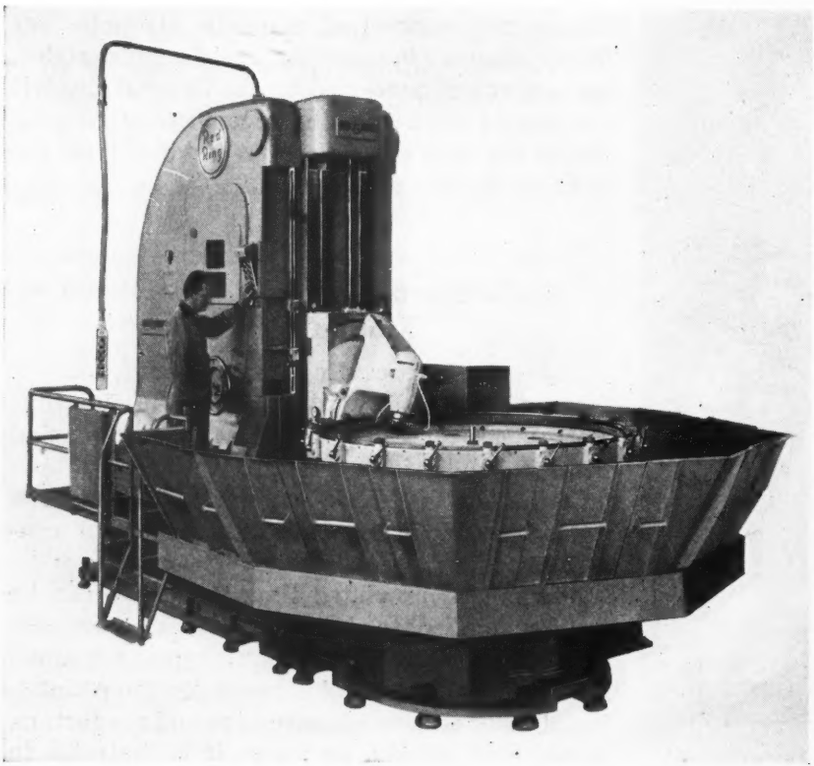


Fig. 1. "Red Ring" gear-shaving machine developed by National Broach & Machine Co. for shaving internal and external spur and helical ring gears of large diameter

To obtain additional information on equipment described here, use Inquiry Card on page 229.

Equipment

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on Market

Edited by FREEMAN C. DUSTON

ciprocating motion exactly parallel with the work-gear axis. This mechanism is also used when it is desired to taper-shave the work-gear teeth. Accurate set-ups are facilitated by a dial indicator, which shows the exact amount of taper in thousandths per inch of gear face width.

The cutter-head slide is provided with both power rapid traverse and power feed, both of which are reversible. A lever on the side of the column permits shifting from one to the other. Power feed may be varied over a wide range through change-gears. The speed of rapid traverse is constant. Electrically controlled stops limit the length of stroke, but these controls can be manually released to permit over-travel of the slide, in order to facilitate withdrawal of cutter from work.

The cutter-spindle is carried on precision anti-friction bearings, designed for maximum rigidity and minimum overhang. A vertical adjustment on the cutter-head is provided to eliminate the need for crossed-axes point spacers and to facilitate cutter removal. The cutter-head is adjusted angularly through a total arc of 30 degrees to obtain any necessary crossed-axes setting. Initial adjustment of this setting is made by means of a vernier scale, and final setting by a built-in dial indicator.

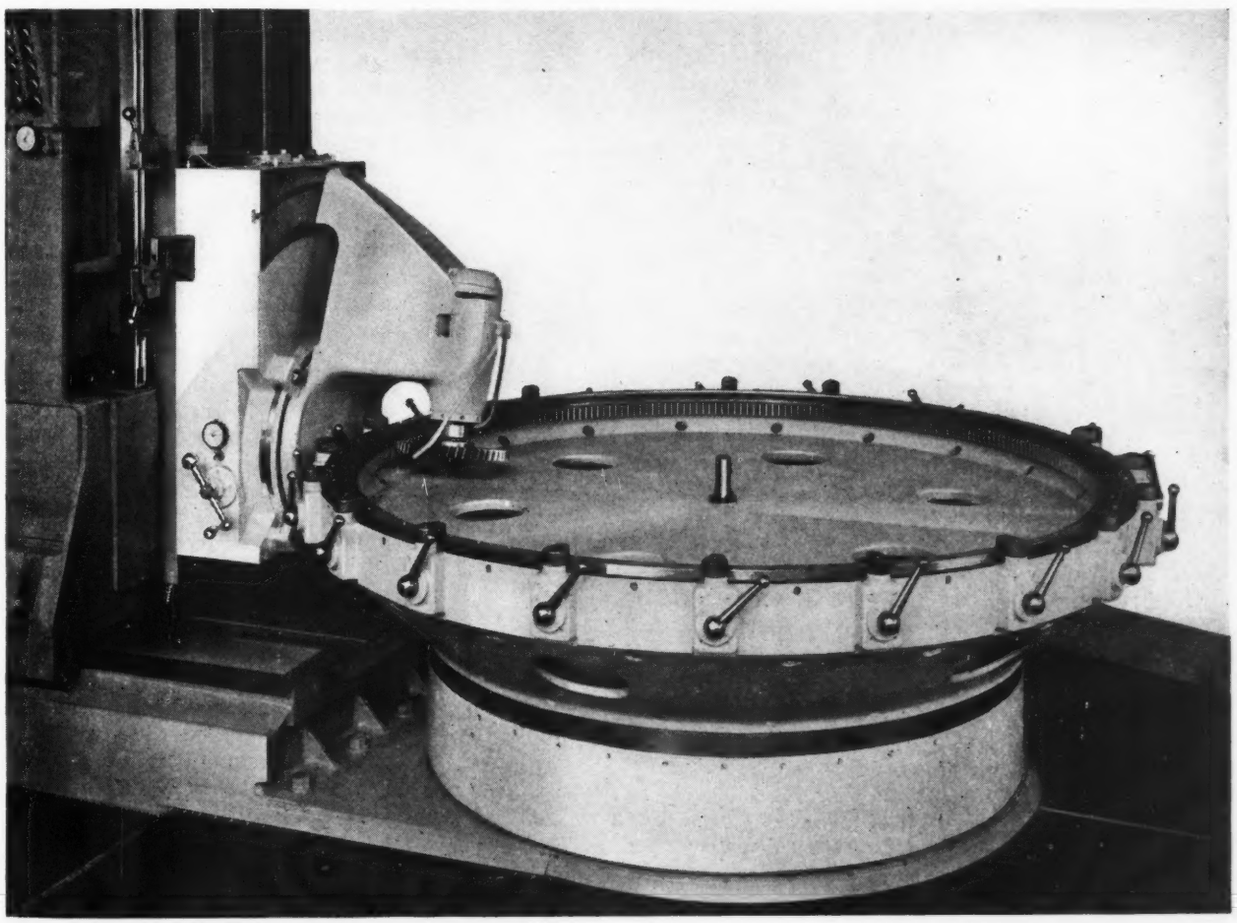


Fig. 2. Close-up view of machine shown in Fig. 1, with splash guards and coolant or chip collector ring removed to permit a clear view of machine table and base

To obtain additional information on equipment described here, use Inquiry Card on page 229.

A central push-button station and selector switch is located on the side of the machine, while a duplicate set of controls in a pendent box is suspended from a swinging over-arm for the convenience of the operator in loading and in setting up.

When an internal gear is loaded on the fixture, the table can be jogged around to facilitate clamping the work. With the work clamped, the column is advanced in rapid traverse until the cutter-head is inside the work-gear. Then the cutter-head slide is lowered by rapid traverse to the height at which the cross-feed stroke is to start. By means of the handwheel, the cutter is then meshed with the work-gear. In the case of an external gear, the same procedure is followed, except that raising and lowering of the cutter-head are not necessary.

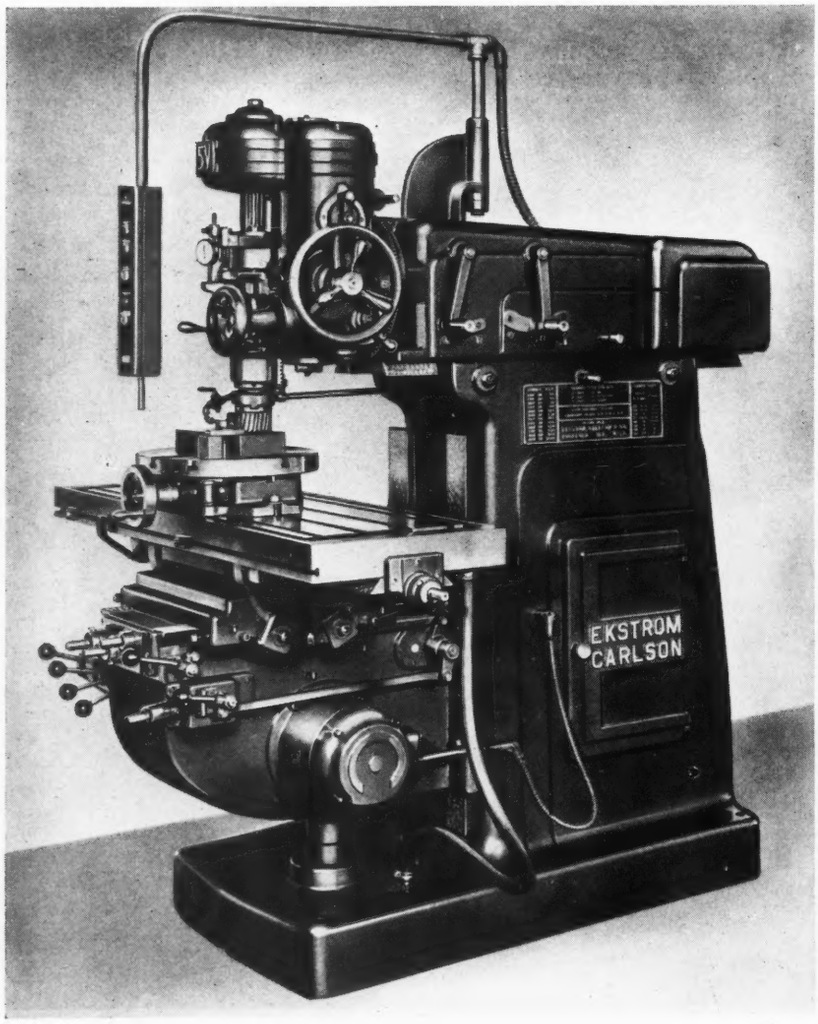
Shaving normally starts with the cutter-head on a down stroke. At the bottom of this stroke, it stops automatically and a signal light comes on. The operator then presses the up-feed push-button, and by means of the handwheel, feeds the cutter one increment into the work. On reaching the top of the return stroke, the cutter again stops and another signal light indicates that the operator can start the next down stroke.

These operations are repeated until the gear has been shaved to the specified size. The column is then withdrawn sufficiently by rapid traverse to disengage the cutter from the work, and the cutter-head is raised by rapid traverse until it clears the level of the fixture. This permits the column to be retracted far enough for the gear to be unloaded.....48

Ekstrom, Carlson Improved "Vertimil"

Ekstrom, Carlson & Co., Rockford, Ill., has announced an improved No. 5V "Vertimil," which is adapted for use in machine tool manufacture, shipbuilding, arsenals, molding and plastics work, die-casting plants, and wherever precision tool and die work is necessary.

Outstanding features of this universal milling machine include ram type head; swivel head; sliding spindle; swivel table; and four-way power feed mechanism. The machine has an unusually large capacity, and is adapted for a wide range of machining operations. It consists essentially of a base and column casting; a horizontally adjustable ram, which is mounted on the column and arranged to support a swivel sliding spindle head and spindle drive; and a tilting work-table mounted on a saddle and knee assembly, which is arranged to provide longitudinal, crosswise, and vertical movements of the table, all of which are power-driven.



"Vertimil" of improved design announced by Ekstrom, Carlson & Co.

The combined adjustments of the tilting spindle, the tilting table, and the ram type head provide the advantages of several different milling machines in one compact unit, and permit the milling of flat, vertical, horizontal, or angular surfaces.

Twelve spindle speeds are provided ranging from 36 to 1200 R.P.M. There are feeds of 0.003, 0.005, and 0.008 inch per revolution in both upward and downward directions. The table is 20 by 56 inches, with a working surface 20 by 48 inches, and is furnished with four 11/16-inch T-slots spaced 4 1/2 inches apart. The table is provided with adjustable stops for both the longitudinal and cross feeds. Rapid location of the 90-degree position of the table and head through the use of special finished lugs serves to eliminate time-consuming gage adjustments.

The tilting member is graduated in degrees and each tenth-degree line is numbered to 30 degrees on each side of the zero position. Tilting of the table is accomplished by means of a worm-gear quadrant mounted on the tilting member and meshing with a worm supported in the lower casting on a keyed operating shaft.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

The ram is a hollow-walled casting, designed to provide sturdy support for the spindle head assembly and gear drive, as well as for the motor. The base of the ram has a dovetail slide, which is machined and scraped to fit the column bearing and is of sufficient length to provide full bearing on the column for all positions of the ram. The ram is moved by means of a rack and pinion, and is arranged for manual operation by a removable hand-crank.

The protected all-gear drive eliminates the necessity for changing belts. Shafts operate in ball bearings, and gears are lubricated by splash and force-feed type lubrication. Standard equipment includes a 3-H.P. two-speed motor for the spindle drive; a 2-H.P. motor for the table feed; and a 1/4-H.P. coolant-pump motor. 49

Micromatic Single-Spindle and Multiple-Spindle Rotating-Base Honing Machines

The Micromatic Hone Corporation, Detroit, Mich., has developed a new type honing unit shown in Fig. 1, for use in close-tolerance finishing of bores that are short in proportion to their diameters. This unit is simple and compact. One motor, mounted on the spindle housing, provides power for both the rotating and reciprocating motions.

The machine has a positive mechanical stroke, which is adjustable up to 2 inches in length. The self-contained unit is supported by two vertical bars. The adjusting head is located in the spindle housing with the expansion indicator dial at eye level. Expansion can be regulated manually or by means of the hydraulically controlled "Microdial." The work-fixture is carried by a saddle that is supported by the same bars that support the head in order to maintain maximum rigidity and accurate alignment.

For high production, four or six of the units can be mounted on a rotating base to make up the "Turret-Hone" shown in Fig. 2. The turret of this machine is designed to rotate continuously at 2 R.P.M., while the operator stands in one position loading and unloading the work-holding fixtures as they pass him.

The operating cycle is as follows: As the fixture leaves the loading position, a hydraulic cylinder lifts it into the honing position. The last increment of travel of the saddle operates a limit switch, which starts the spindle

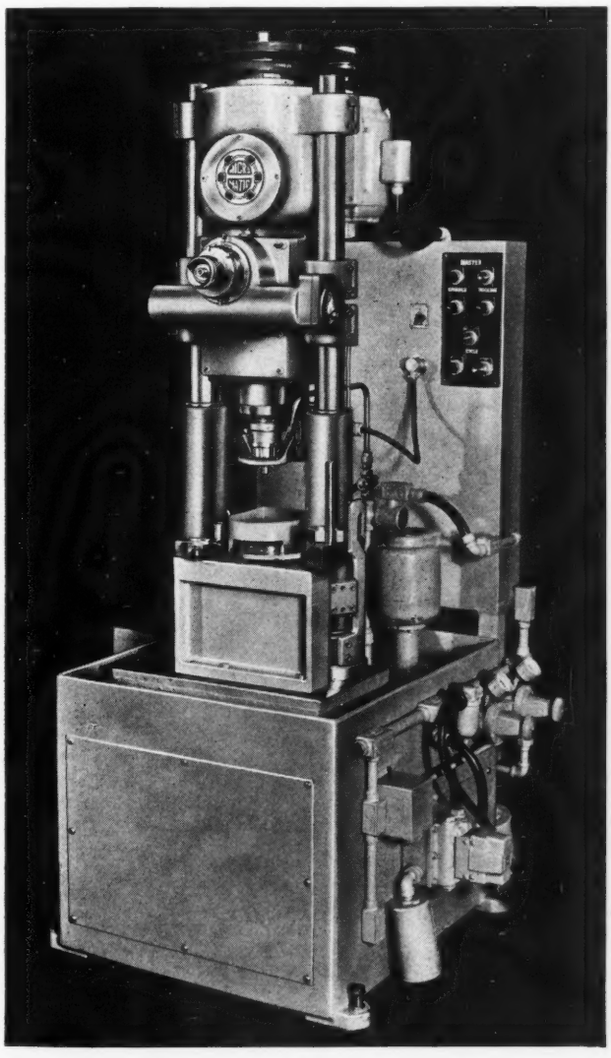


Fig. 1. Micromatic honing unit for honing short bores, which automatically loads and ejects the work-piece

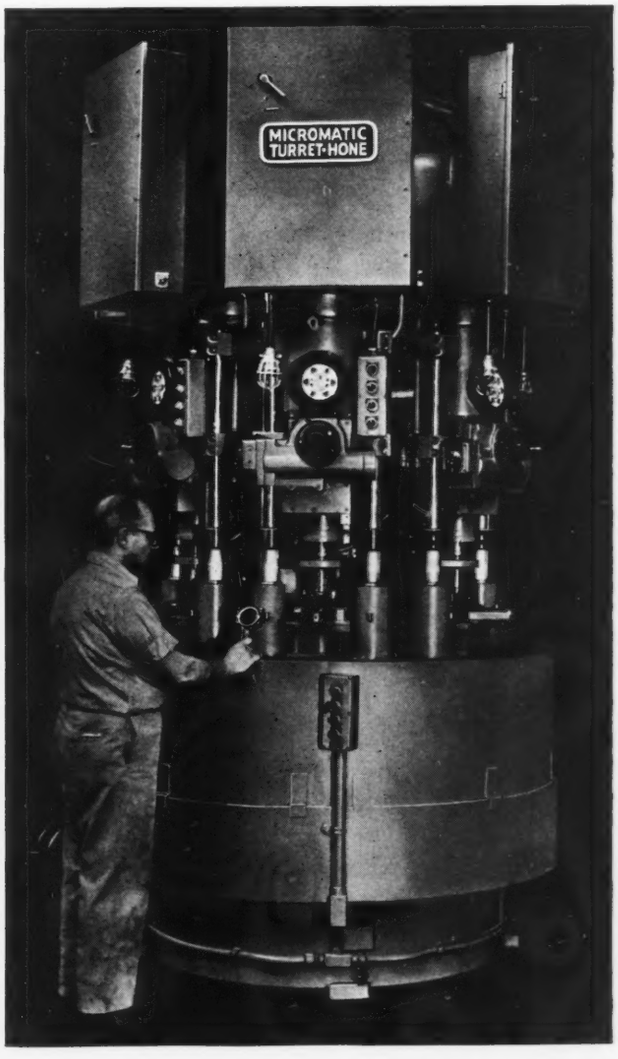


Fig. 2. "Turret-Hone" equipped for honing automotive connecting-rods at rate of more than 700 rods per hour

To obtain additional information on equipment described here, use Inquiry Card on page 229.

rotating and reciprocating. At the same time, the "Microdial" expands the tool at a controlled, positive rate. If the part is to be clamped, the tool expands to rough-bore size and locates the part, after which the part is automatically clamped just before the honing operation begins.

When the bore is honed to the desired size, the "Microsize" control stops the expansion of the tool, provides a run-out period, collapses the tool, stops the spindle, and drops or lowers the fixture. When the unit enters the loading position, the operator unloads the fixture, and slips another part in place, after which the cycle is repeated.

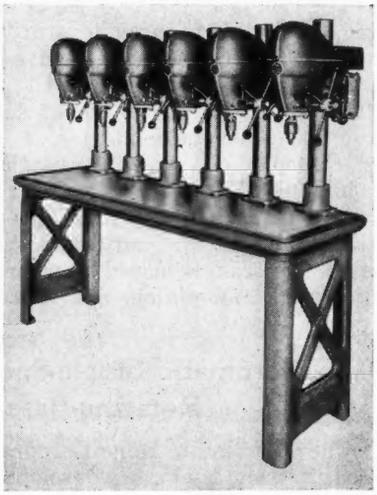
These machines are easily adapted for honing any bore less than 4 inches in diameter and under 2 1/2 inches in length. 50

Reed-Prentice Improved Cold-Chamber Die-Casting Machines

An improved "shot" plunger is an outstanding feature of two new model cold-chamber die-casting machines manufactured by the Reed-Prentice Corporation, Worcester, Mass. This feature has been especially developed to assure better results in die-casting aluminum and magnesium parts. The plunger speed of 10,000 inches per minute required for magnesium die-casting is attained through a 3-inch two-way valve that is integral with the "shot" cylinder, and by a special prefill arrangement, which results in higher quality castings. With this arrangement, the plunger moves at low pressure until the mold is filled, at which time the maximum pressure is applied instantaneously.

The Model 1 1/2G machine develops 250 tons die locking pressure, and will cast aluminum parts weighing up to 3.75 pounds and magnesium parts weighing up to 2.4 pounds. The Model 2G machine, shown in the illustration, exerts a clamping pressure of 400 tons, and has a "shot" capacity of 9 pounds of aluminum and 6 pounds of magnesium.

Both models have four tie-bar construction and a sliding support bracket for the movable die plate, which maintains accurate die alignment under continuous operation. Die plates on the Model 1 1/2G machine measure 32 by 29 inches, while those of the Model 2G machine measure 38 by 36 inches. The machines weigh 14,500 and 22,700 pounds. 51

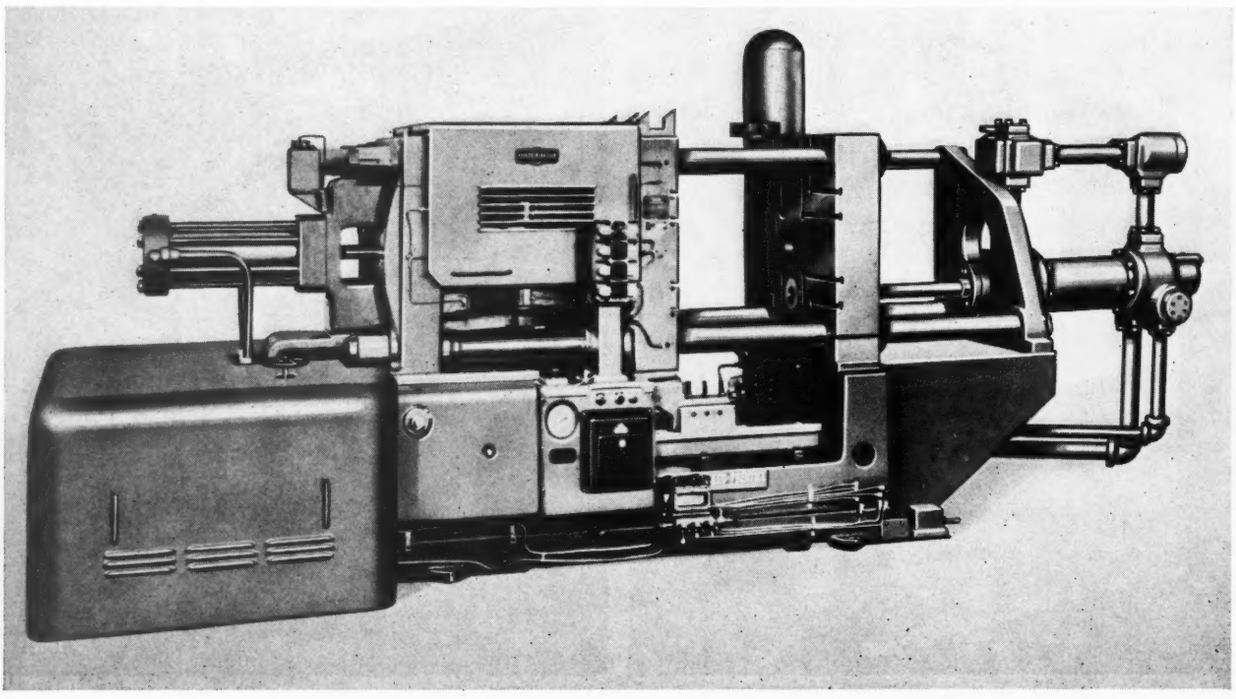


Multiple - spindle drill press built by Toolcraft Corporation

Darra-James Multiple-Spindle Drill Presses

The Toolcraft Corporation, Springfield, Mass., has announced a new line of heavy-duty multiple-spindle drill presses. These 15-inch production model machines are available with from one to six heads mounted on a large rugged table having cast-iron legs.

New features included in these machines are self-aligning grease-sealed ball bearings; double hinged guard; and free floating six-spline spindles. 52



Cold-chamber die-casting machine with improved "shot" plunger, built by Reed-Prentice Corporation

To obtain additional information on equipment described here, use Inquiry Card on page 229.

Baldwin Tension and Compression Testing Machine

An improved, low-cost universal testing machine of 12,000 pounds capacity has been added to the line of the Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa. This new Model 12-H has many of the features of the large Baldwin testing machines, such as separation of the hydraulic loading unit from the indicating and control unit, as shown in the illustration. This feature isolates recoil from breaking test specimens and permits adjusting the maximum or "lazy" hands with minimum drag.

An exceptionally rigid, two-column design with 9 1/2 inches of lateral space between columns provides easy accessibility in handling specimens, and permits a clearer view of the pieces undergoing tests.

Loads for either the tension or compression tests are applied in an upward direction by a piston and elevating cage consisting of the table, two uprights, and an upper gripping head, all of which have an 8-inch stroke. The loading speed can be varied by stepless adjustment between 0 and 10 inches per minute.

The vertical distance between gripping heads can be adjusted from 1 inch to 21 inches, the latter distance including the stroke length. The table is arranged for transverse testing.

Loading controls govern the flow of oil to the loading cylinder by means of three valves, one for directional control, one for loading, and the other for unloading. Automatic safety devices protect the gages against overloads and prevent over-travel of moving parts.

Two capacity ranges are provided. The 12,000-pound range is graduated in 20-pound units on a 16-inch diameter indicator dial, and the 3000-pound range is graduated in 5-pound units. Ranges other than standard are 600, 1200, 2000, and 6000 pounds, available in any dual combination. 53

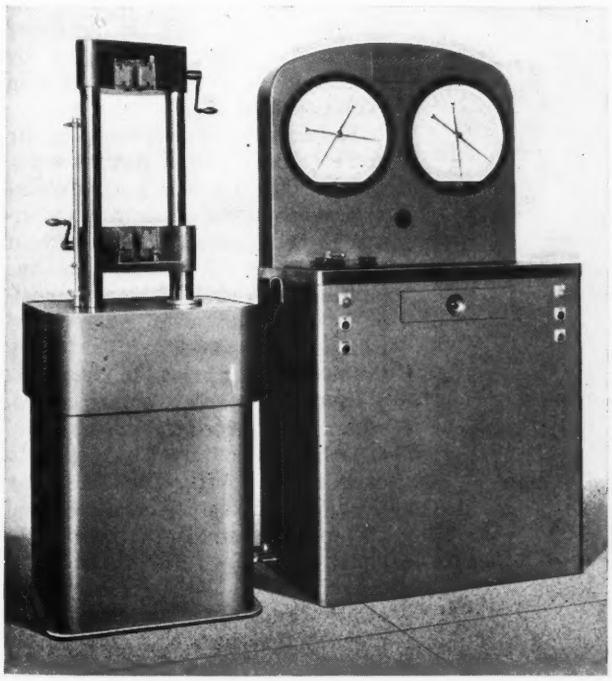
Large-Capacity Multi-Purpose Band Saw

Features that characterize the new multi-purpose band saw brought out by the DoAll Co., Des Plaines, Ill., include extra work height capacity, combined standard drive and feed components, job selector, built-in hydraulic pressure system, convenient feed regulator control, and adjustable upper and lower guide posts.

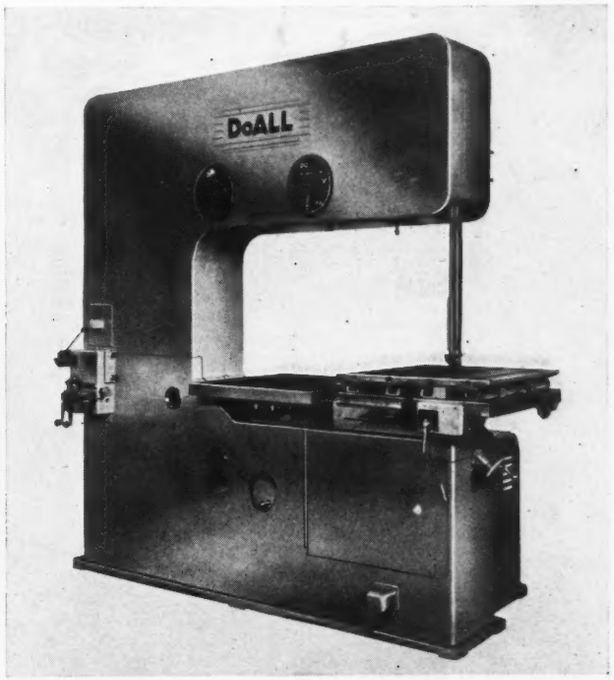
The welding unit of this band saw joins and anneals all band widths up to 2 inches and includes a motorized grinder and blade squaring shear. Job selector dials cover blade speed and feed recommendations for all types of materials over the available speed range, which is 40 to 10,000 feet per minute. The speeds are controlled by handwheel through a three-speed transmission and variable pitch diameter "Speedmaster" drive.

The 16-inch stroke, hydraulically powered work-table is used for power feeding to assure straight vertical cuts. The table can be tilted 45 degrees right and 10 degrees left for angular cuts and beveling operations. A heavy steel guard covers the blade to the point of work. The adjustable upper and lower guide posts make it possible to maintain the best possible guide position.

At conventional metal cutting rates, the machine will saw or file tool steel, large forgings and castings, or structural shapes. At high speeds, it will cut or polish nonmetallic and composition materials, laminated products, and speed, it will cut stainless and heat-resistant alloys, sheet metal, non-ferrous substances. At top galvanized corrugated sheathing, building panels, and similar materials. The machine is driven by a 7 1/2-H.P. motor. 54

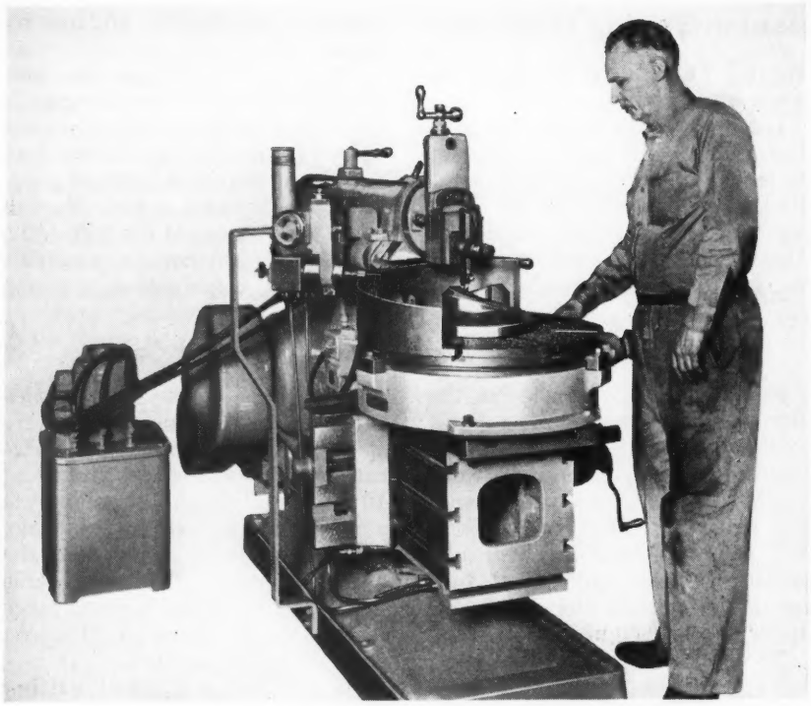


Hydraulic loading and control units of Baldwin compression and tension testing equipment



Large-capacity multi-purpose motor-driven band saw placed on the market by the DoAll Co.

To obtain additional information on equipment described here, use Inquiry Card on page 229.



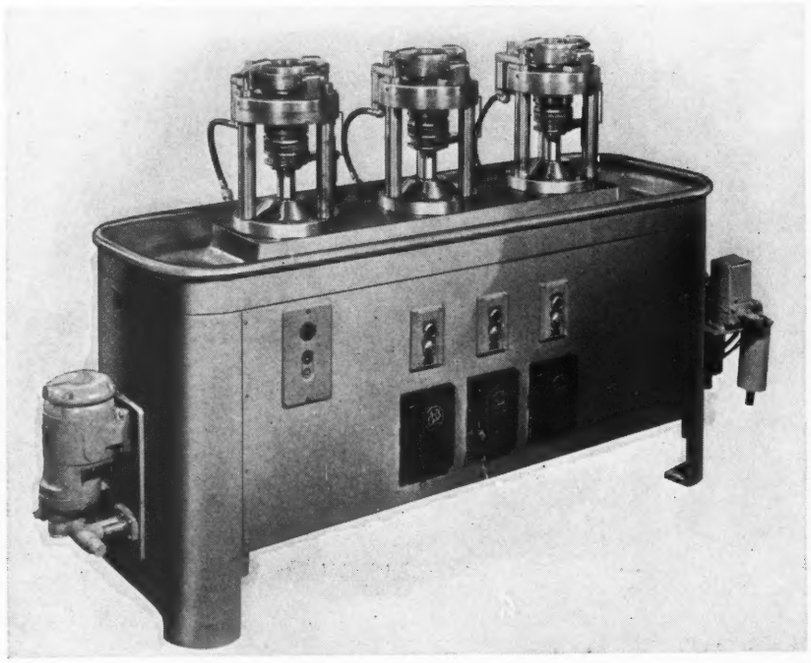
Cincinnati shaper with Turchan hydraulic duplicator

Cincinnati Shaper Equipped with Turchan Hydraulic Duplicator

The Cincinnati Shaper Co., Cincinnati, Ohio, has announced that its new 24-inch shaper has been equipped with a Turchan hydraulic duplicator and a special rotary table, as shown in the illustration. With this equipment, interchangeable mating sections of brake mechanisms for overhead cranes are made in a single operation in a fraction of the time previously required.

The follower equipment consists of a motor and pump shown at the left of the shaper; a stylus-operated hydraulic valve; a template; and a hydraulic cylinder attached to the elevating screw. The table feed is automatic, and can be either horizontal or circular. The template operates the stylus and control valve, which, in turn, causes the table to move up or down as required. The depth of cut is controlled by the tool-slide feed-screw.

By using the follower in connection with a low-cost sheet-metal template, intricate forms can be produced quickly with inexpensive single-point tools. This equipment is especially adapted for use where a relatively small quantity of parts is required and where the use of form cutters would make the tool cost prohibitive. ---------- 55



Threading machine announced by the D. H. Prutton Machinery Co.

Prutton Threading Machine

Production threading of work up to 4 inches in diameter with 11 threads per inch can be accomplished on a new tapping machine developed by the D. H. Prutton Machinery Co., Cleveland, Ohio. This Model 40A machine is especially suited for use in threading shells, tubing, and all work requiring fine-pitch threads.

Three driving motors of 3 H.P. insure ample power for uninterrupted cutting during the tapping operations. The separate drives permit the operator to run one spindle or all three in sequence for fast continuous feeding by changing the work-pieces between each operation.

The fixtures are operated by air and controlled by a limit switch, which coordinates other mechanical movements designed to increase the production capacity of the machine. A master cam has eliminated the lead-screw previously used, and permits the use of collapsible taps. The tap, fed by the master cam, rises to the workpiece at the correct tapping speed, which is selected from the combination speed pulley attached to each drive. After the threading is completed the tap collapses, and the master cam is in position to change the feed for facing and chamfering. The master cam clears the head from the workpiece, and returns it to its original position, ready to begin the next cycle. This arrangement eliminates the necessity for reversing the drive.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

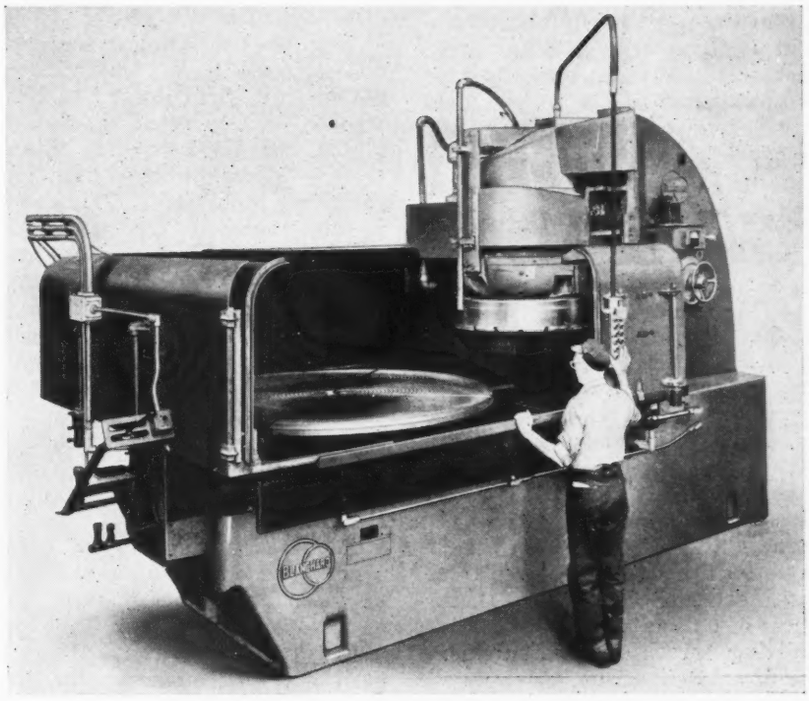
Lubricant is pressure-fed from a reservoir to separate feed lines for each head. A perforated ring in the tapping fixture directs the flow of lubricant at an angle on four sides of the tap. The lubricant flow starts before the thread cutting begins, and continues throughout the cutting cycle.

The machine occupies a floor space of 72 by 24 inches, and has an over-all height of 4 feet.....56

Blanchard Rotary-Table Vertical-Spindle Surface Grinding Machine

The large surface grinder illustrated has been added to the line of the Blanchard Machine Co., Cambridge, Mass. This massive new grinder is of the rotary-table vertical-spindle type, and is designated No. 42-72-84. The abrasive wheel is 42 inches in diameter. The magnetic work-table is 72 inches in diameter, and is machined from a solid steel disc. A 6-inch wide non-magnetic extension ring around the table increases the diameter to 84 inches.

The wheel-spindle can be equipped with a 75- or 100-H.P. built-in electric motor. The grinder is 10 feet 7 inches wide by 20 feet long, and weighs over 30 tons. 57

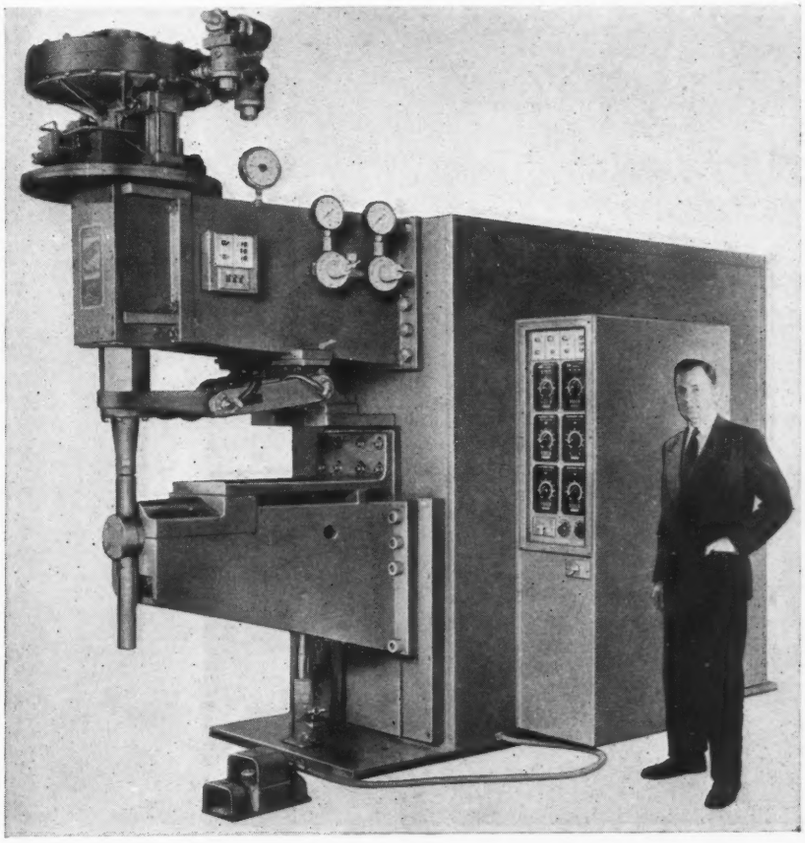


Rotary-table surface grinder made by the Blanchard Machine Co.

Sciaky Three-Phase "Modu-Wave" Spot-Welding Machine

An exceptionally powerful three-phase "Modu-Wave" spot-welder is a recent development of Sciaky Bros., Inc., Chicago, Ill. An electrode force adjustable up to 23,000 pounds and a rating of only 400 KVA are said to make this machine capable of exceeding the rigid requirements of the Air Force-Navy Aeronautical Specifications. It is claimed that two thicknesses of 1/4-inch aluminum-alloy sheets can be spot-welded on a high-production basis with this new welder.

Control functions and other features developed to increase the efficiency of this spot-welder include an extremely rapid rate in the rise of the forging pressure, achieved through the use of a frictionless diaphragm pneumatic pressure system, which assures quick follow-up pressure; a "tailor-made" wave shape, adjustable to suit any given spot-welding application, obtained by the three-phase "Modu-Wave" system, which eliminates the necessity of making prolonged compromises between current, timing, and pressure sequences; and improved current conductance efficiency of



Heavy-duty machine for spot-welding aluminum developed by Sciaky Bros., Inc.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

the secondary circuit resulting from the use of solid electrolytic copper bars with sliding silver contacts at each terminal for transmitting the secondary current from the transformer to the movable electrode. 58

New Projection Lens for Jones & Lamson Optical Comparator

The Jones & Lamson Machine Co., Springfield, Vt., has recently perfected a 5-magnification projection lens with a 6-inch aperture and a 12-inch focal clearance for the optical comparators made by the company. With this lens equipment, the contour of any object that will fall within a 6-inch circle can be projected in its entirety with extreme accuracy and sharpness of outline, on the 30-inch receiving screen for measurement or direct comparison.

The large aperture provided by the new lens permits direct overall inspection of a wide variety of relatively large objects. Typical applications of this new equipment include the inspection of cams, templates, airfoil sections, and cutters. 59

Oilgear Special-Purpose Machines

Two presses designed for special purposes have recently been developed by the Oilgear Co., Milwaukee, Wis. One of these—the 75-ton two-column press illustrated—is designed essentially for extruding pencil leads. This press is also adapted for extruding ceramics, graphite, crayons, etc. The press has positive, fine, steady, variable ram speeds and high approach and return speeds provided by an Oilgear feed pump. A variable-delivery pump, mounted on a common oil reservoir, serves to extend the extruding speed range. Each pump is driven by a separate direct-connected electric motor.

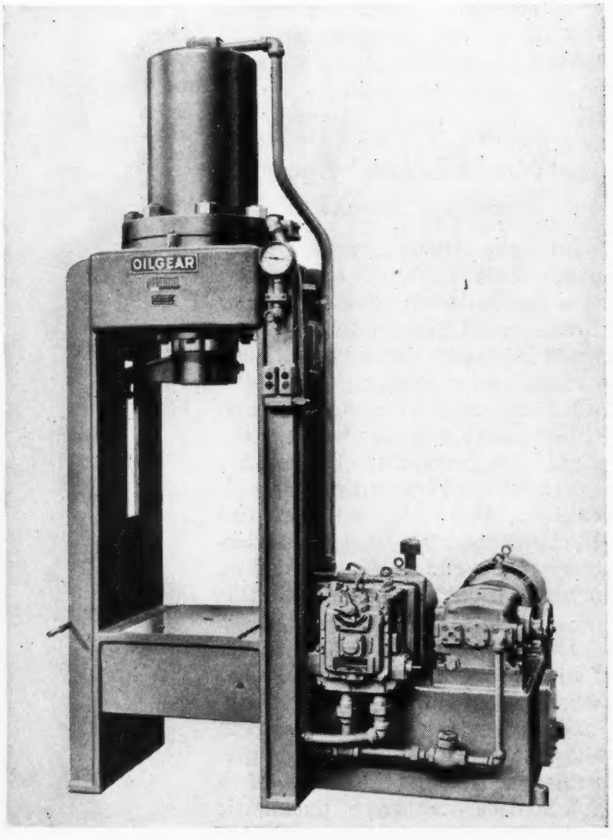
The feed pump can be used alone when employing ram feeds up to 2.2 inches per minute. In operation, the control lever is moved to the "Traverse Down" position. As the ram approaches the work, the lever is released and the linkage automatically moves the lever to "Extrude" position. Downward movement of the ram at extruding speeds continues until the adjustable collar on the control rod strikes a pawl which releases the linkage and allows it to move the control lever to "Traverse Up" position. The ram then moves upward until it strikes an adjustable collar and linkage which moves the lever to "Neutral" position.

The ram has a stroke of 18 inches, daylight capacity of 36 inches, distance between columns of 24 inches, distance from front to back of 24 inches, and table height of 24 inches. The weight of the machine is 7480 pounds.

The other special-purpose machine is a 35-ton two-column vertical press, designed to draw gold blanks into long tubes for optical use. This press is designed for a maximum capacity of 50 tons. It carries the accurately guided drawing tool on lubricated, hardened and ground ways bolted to the inside of the press frame. Push-button control provides for both manual and semi-automatic operation, as well as emergency stop or reversal at any point in the operating cycle.

An Oilgear two-way variable-delivery pump is direct-connected to a 20-H.P. electric motor. Only two pipe lines are required with this arrangement. Cams on the

Jones & Lamson optical comparator with new projection lens



Oilgear special two-column vertical extruding press

To obtain additional information on equipment described here, use Inquiry Card on page 229.

cross-head provide both stroke adjustment and top and bottom points of reversal adjustment for the cross-head.

The drawing speed is variable up to 144 inches per minute, and the return speed up to 288 inches per minute. The press has a stroke of 28 inches, daylight capacity of 40 inches, distance between columns of 24 inches, distance from front to back of 24 inches, and table height of 30 inches. The over-all height is 149 inches, and the weight 12,000 pounds. 60

Perkins Straight-Side Single-Crank Press

A new straight-side single-crank press has recently been announced by the Perkins Machine Co., Warren, Mass., which is designed to fill the need for a versatile production machine of this type. The new Model 12-H-36 press is sturdily built for economical operation, and is especially designed for convenience of operation and easy accessibility in changing dies. It has a capacity of 200 tons, a bed area of 36 by 36 inches, and a main bearing diameter of 8 inches. 61

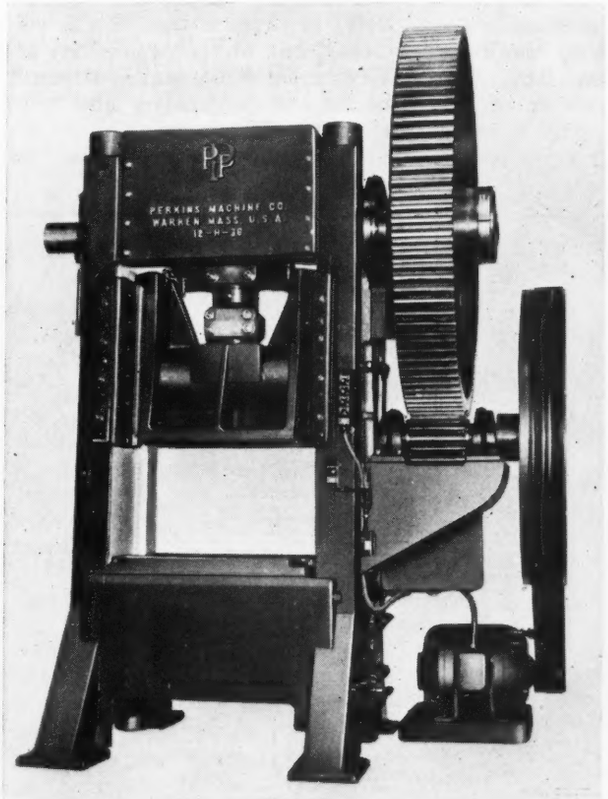
Richmond Radial Drilling Machine

The Richmond HB3 4 1/2-foot radial drilling machine shown in the illustration is manufactured by Midgley & Sutcliffe, Leeds, England, and is being introduced in this country by British Industries Corporation, International Machinery Division, New York City.

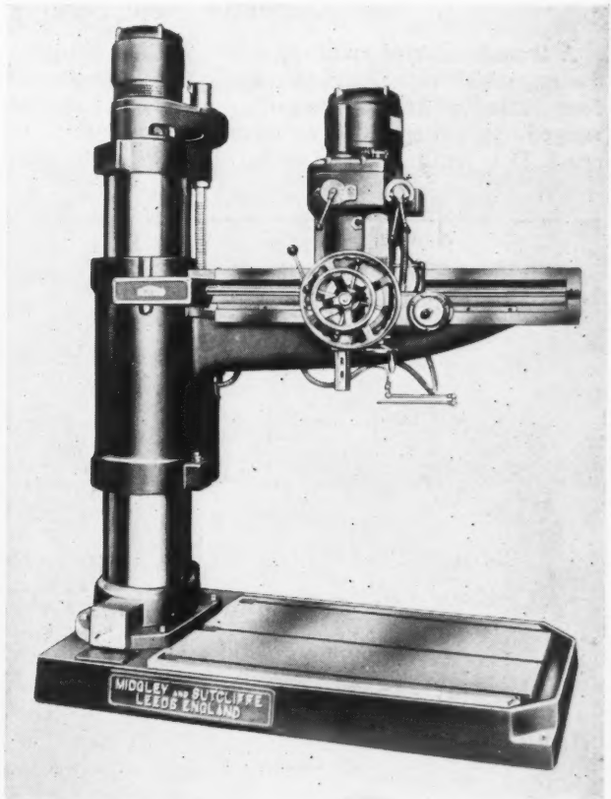
This machine is designed to obtain extreme accuracy. Outstanding features include rigid, compact design; control levers arranged to reduce fatigue and idle time to a minimum; electric drive having one motor for drilling and one for elevating, both of which are controlled by a single switch on the saddle and a built-in operating panel in the rear of the radial arm; driving gears made from chromium-nickel steel, heat-treated and ground on the tooth surfaces; shafts of high-carbon heat-treated steel supported in ball bearings, and sliding gears mounted on six-spline shafts; wide range of spindle speeds adapted for economical tapping, boring, and drilling in steels or alloys; positive lubrication of saddle gears by built-in pump; and 220-volt three-phase, 60-cycle electrical equipment designed to NEMA standards.

The baseplate has three T-slots running its entire length. Coolant drains along wide channels around the base to a large-capacity interior reservoir. The arm is of box type construction diagonally ribbed internally to withstand drilling stresses. It has annular roller bearings at the top and bottom of the long parallel portion. Power is supplied through a collector ring at the top of the column which allows the arm to swing through an angle of 360 degrees. The box-section saddle totally encloses all mechanisms.

The spindle is of high-carbon steel, the nose being bored to fit a No. 4 Morse taper. Quick hand traverse, fine hand feed, and automatic feed are provided. An automatic depth trip can be set for any predetermined depth of hole. Spindle speeds range from 20 to 1800 R.P.M. One lever controls the forward and reverse rotation of the spindle, as well as the raising and lowering of the arms. The driving gears in the saddle are lubricated by means of a built-in pump. 62



Heavy-duty straight-side single-crank press placed on the market by the Perkins Machine Co.



Drilling machine introduced by British Industries Corporation, International Machinery Division

To obtain additional information on equipment described here, use Inquiry Card on page 229.

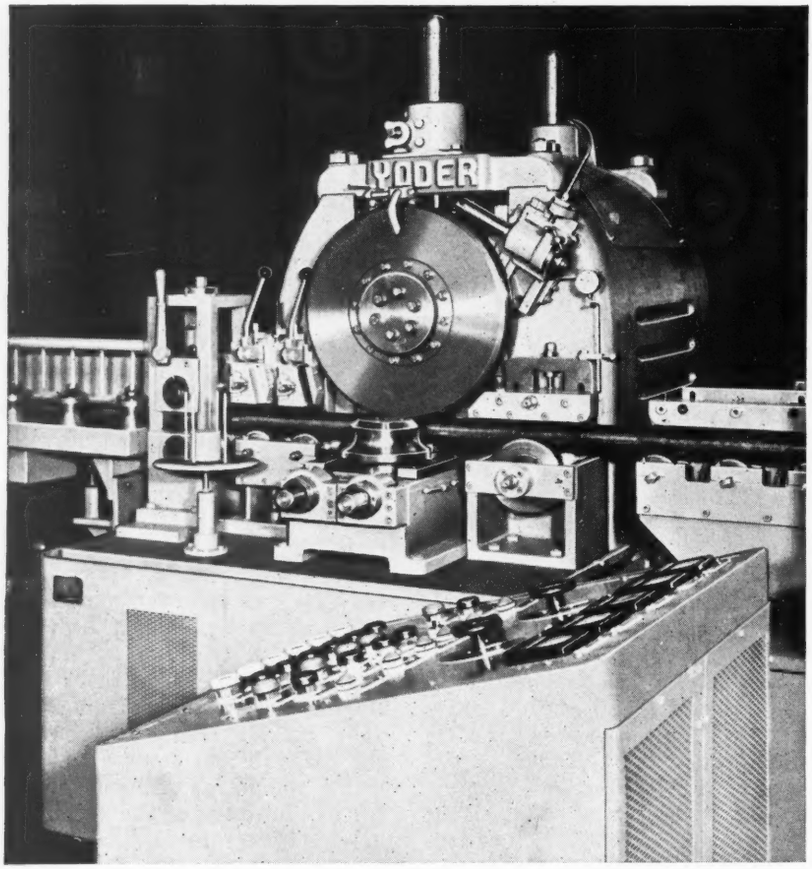


Fig. 1. Front view of new Yoder welding machine with control cabinet seen in the foreground

Yoder Tube Welding Machine with Transformer of Radically New Design

A transformer of radically new design, which actually consists of four smaller transformers arranged approximately in an offset cross, is a feature of a new tube welder brought out by the Yoder Co., Cleveland, Ohio. The single transformer core shown in the cross-section view, Fig. 2, is enveloped by the four transformers (not shown), so that the flux patterns in the four sections are identical. Aside from the rear mechanical pads and the common core, the construction of the individual transformers is the same as that of any conventional welding transformer. All secondary electrical current paths within the transformer are through continuous copper, a feature not feasible in the circular type transformers previously used.

By using four smaller transformer units instead of a large single unit, impedance is reduced to such an extent that one of the new transformers of, say, 200-KVA capacity, will have a percentage of impedance as low as that of a 50-KVA transformer of the older type.

The arrangement of the secondary pads is also ideal for transferring power through concentric conductors, and provides the best electrical and mechanical joint between transformer and secondary conductors. It also has the advantage of making possible the use of very short conductors to the electrodes. This feature contributes further toward high efficiency, and at the same time, affords greater mechanical strength because of the shorter and more rigid rotating assembly.

Tests made on the new welder

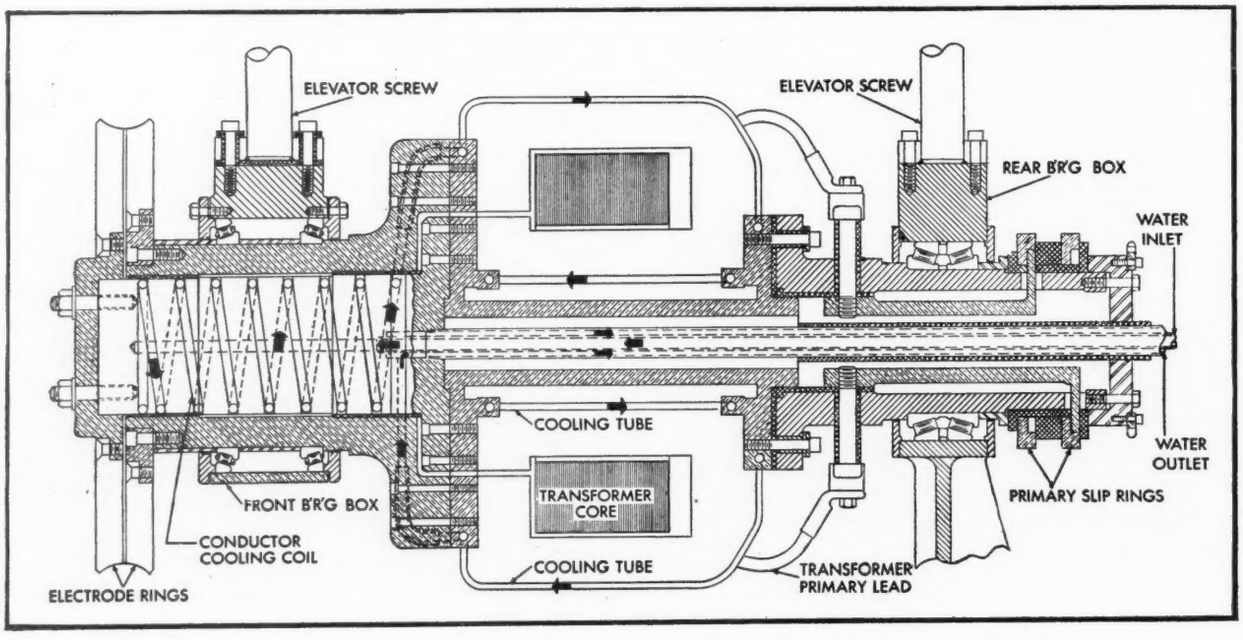


Fig. 2. Longitudinal cross-section of Yoder welding machine transformer, showing water cooling circulating system

To obtain additional information on equipment described here, use Inquiry Card on page 229.

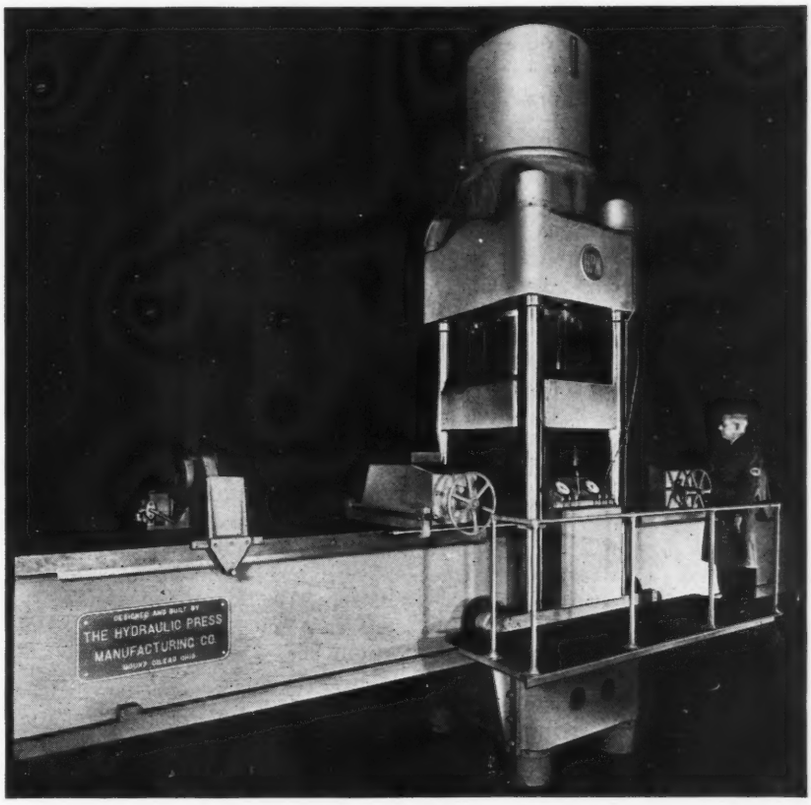
are said to have shown impedance reduction of 15 to 20 per cent, compared with the best results previously obtained. Higher production welding speeds with lower power costs are advantages resulting from the new design features incorporated in this welder.....63

Gun Straightening Press

The Hydraulic Press Mfg. Co., Mount Gilead, Ohio, has constructed a 1500-ton gun-barrel straightening press for the Dixson Gun Plant, Houston, Tex. This press is designed to apply pressure to various sections of the forged barrel after it has been positioned on the bed of the machine.

In operation, the entire cylinder and ram assembly traverses horizontally along the bed. The press is equipped with a 28- by 3-foot bed, and the cylinder and ram assembly can travel a maximum horizontal distance of 17 feet. The drive is by a "Fastraverse" hydraulic power system, which allows operation at high speed cycles, with rapid advance to the work, automatic slow-down while pressure is being applied, and rapid return for the next cycle.

In addition to gun-barrel straightening, the press is also well adapted for straightening weldments, forgings, castings, plates, and various structural shapes. 64



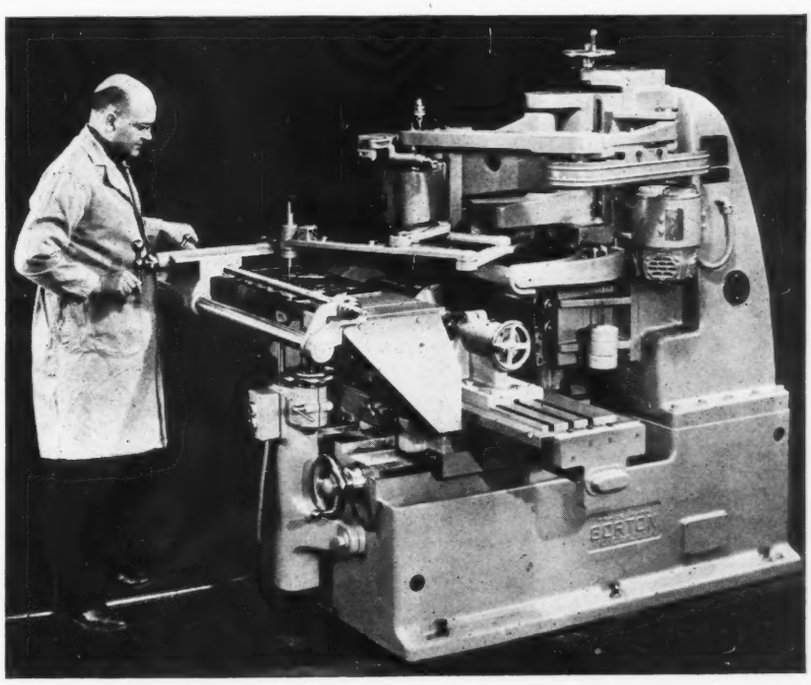
Press for straightening gun barrels, built by the Hydraulic Press Mfg. Co.

Gorton Machine for Milling, Routing, and Engraving Cylinders

A completely new pantograph machine has been designed by the George Gorton Machine Co., Racine, Wis., for performing accurate milling, routing, and engraving operations on the cylindrical surfaces of rolls and cylinders. It is suitable for a wide range of industrial applications.

An important advantage of this machine is that it can be easily modified to meet a wide range of requirements as to ratio of reduction and roll diameter. The machine accommodates rolls (metal and plastic) from 6 inches to 12 inches in diameter and up to 40 inches long. The work-piece is held between centers. Movement of the tracer forward and backward automatically rotates the roll, but left to right movement does not cause rotation of the roll; thus, the cutter point is always centered over the axis of the work-piece.

The maximum area covered by the cutter at one setting is 5 by 20 inches. A master pattern, twice the desired size, is cut in flat brass, sheet iron, zinc, or sheet plastic, in either sunk or relieved form. Only a small segment is required of the entire design if it is to be repeated all around the roll. The master is clamped to the table at front of machine.



Gorton machine for milling, routing, and engraving cylinders

For heavy roughing cuts, a built-in manual scanning attachment is furnished, into which the tracing spindle is clamped. This is operated manually by means of longitudinal and transverse feed-screws, which permit much heavier cuts with positive control in the roughing operation.

No gears are used in this machine, the correct speed of rotation for reproducing the master completely around rolls of any diameter within the capacity of the machine being provided by a built-in compensating mechanism. This eliminates the need for change-gears and permits accurate work on rolls of infinitely varying diameters.

Either a toggle switch on the tracer spindle or a foot-switch can be furnished to feed the cutter-spindle down to cutting depth or to release it. There is also a 1-inch vertical micrometer adjustment on the cutter-spindle. The precision heavy-duty spindle of the machine is belt-driven by a 1/2-H.P., variable-speed, direct-current motor, which provides infinitely variable speeds of 500 to 12,000 R.P.M. This speed range can be changed, however, to meet specific requirements.

The roll is rotated automatically during the cutting operation by the headstock drive. The tailstock center floats on anti-friction bearings. The rotating mechanism—an exclusive Gorton development—is completely synchronized with the cross movement of the tracer spindle. The master table is easily swung aside to permit loading and unloading of heavy rolls.

The machine weighs approximately 10,650 pounds, and requires a floor area of about 80 by 87 inches. 65

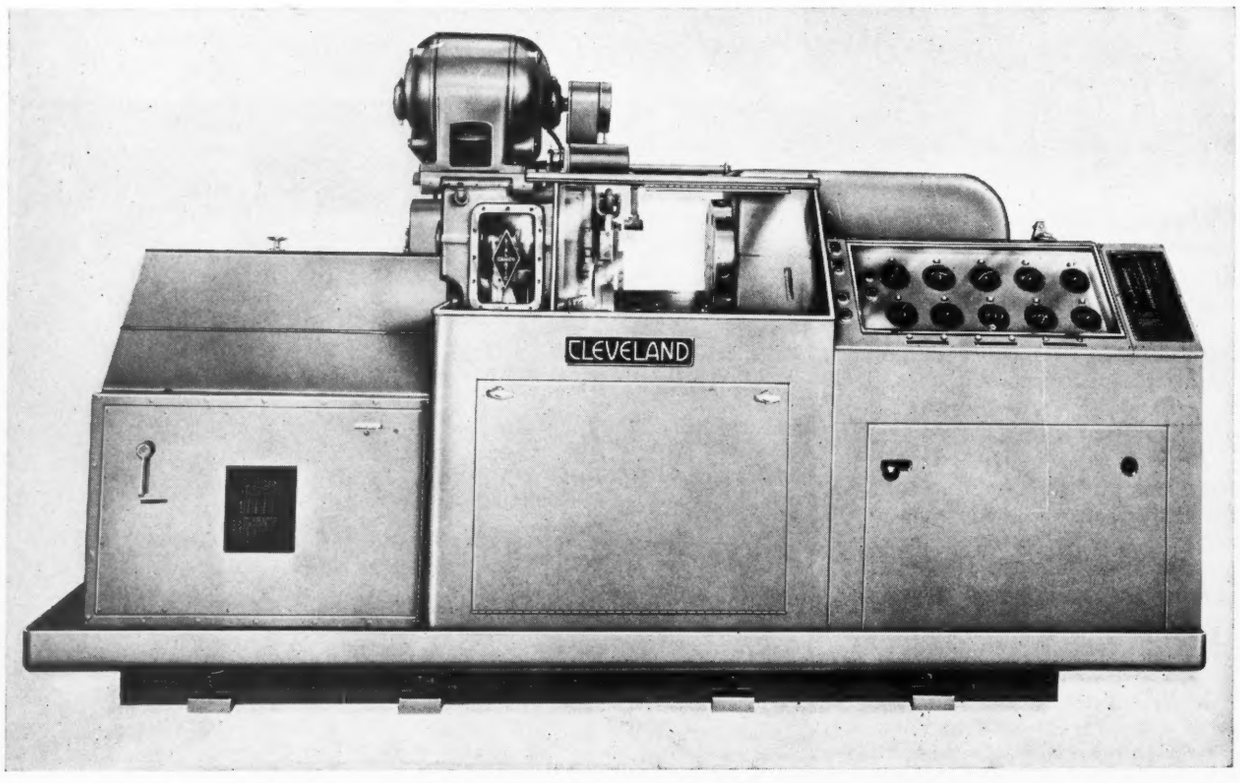
Cleveland Redesigned Single-Spindle "Dialmatic"

The Model AB "Dialmatic," built by the Cleveland Automatic Machine Co., Cincinnati, Ohio, has been redesigned and several new features have been added to improve its flexibility and performance. One improvement in this single-spindle automatic machine is the substitution of a dynamatic coupling and a conventional feed motor for the motor-generator set and direct-current motor formerly used for the electric feed drive. This new drive permits control of the turret feeds without requiring cam changes. It consists of a control panel, feed calculation chart, 3-H.P. feed motor, dynamatic coupling, rotary selector switch, shifting disc, and shifting mechanism.

The speed of the inner or driven member of the dynamatic coupling is controlled by rheostat settings and a rotary selector switch with ten sets of contacts driven by the camshaft, which selects the proper rheostat for each turret position. Thus, separate, infinitely adjustable feeds can be preselected for both forward and return motion of each of the five turret positions, and the feed rate for any turret tool can be changed while it is cutting, making it possible to easily set the machine for maximum production.

The machine has 112 spindle speeds ranging from 24 to 1820 R.P.M., which provides for efficient cutting of all kinds of metal and the use of all types of cutting tools. Four automatic spindle speed changes, both forward and reverse, are available for each set of change-gears. The disc type friction clutch in the spindle head is shifted automatically by a small hydraulic cylinder in the same manner that the feed-bracket clutch is shifted.

The new automatic is built in both a 2 1/2-inch capacity and a 3-inch capacity bar type machine. However, a simple chucking at-



Single-spindle "Dialmatic" of improved design announced by the Cleveland Automatic Machine Co.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

tachment can be quickly substituted for the bar-stock feed assembly to convert either machine for chucking operations. 66

Spot-Welder for Foil and Screen Repair Work

A precision-built portable resistance spot-welder is now available for repair of Inconel and stainless-steel foil and screen material and for making alterations required by changes in design. This compact spot-welder equipment, known at the "Hit-Kit," was developed by the H. I. Thompson Co., Los Angeles, Calif.

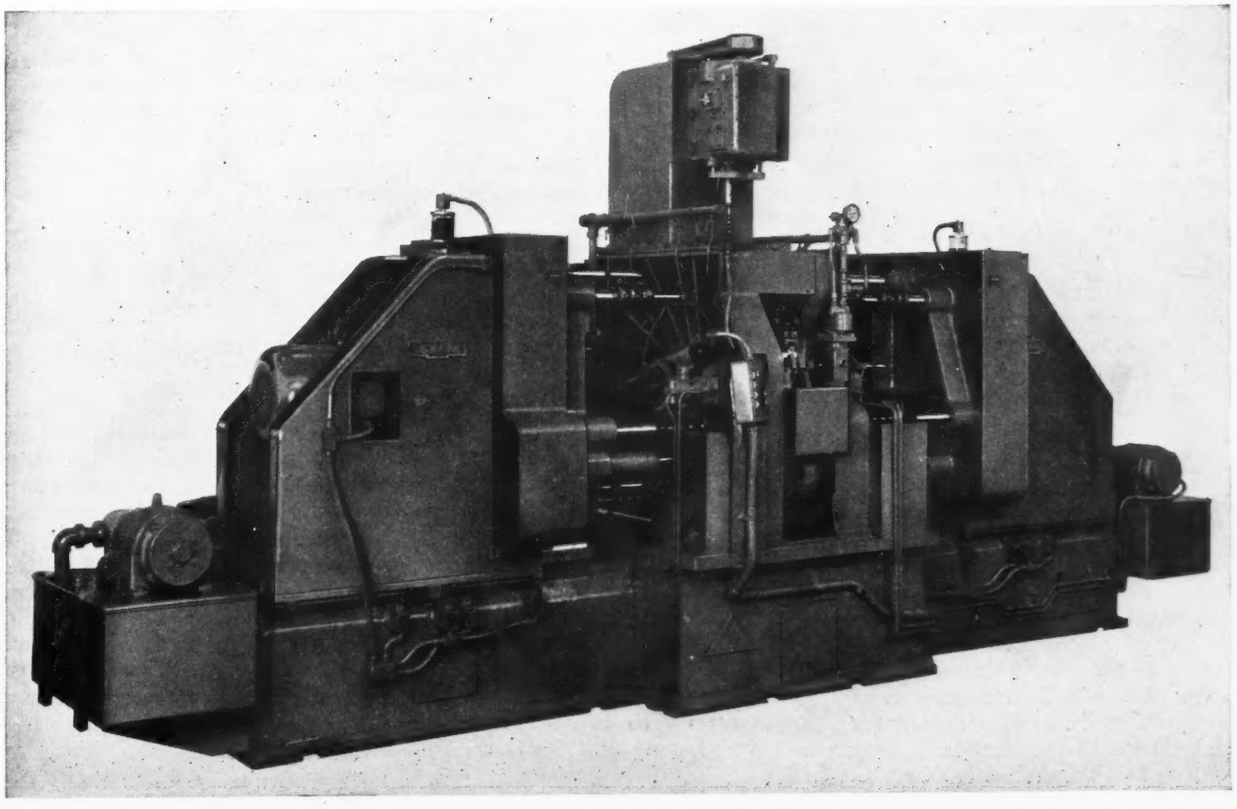
The foil is securely welded in place by bringing both electrodes into contact with the foil surface and inducing current by operating a trigger switch. The welder is equipped with leads 9 feet in length, attached to welding tips, and operates on 110-volt alternating current. Foil thicknesses up to 0.004 inch and screen wire diameters up to 0.020 inch can be welded. The complete welding outfit is contained in a portable case provided with a tray.....67

Portable spot-welder made by the H. I. Thompson Co.

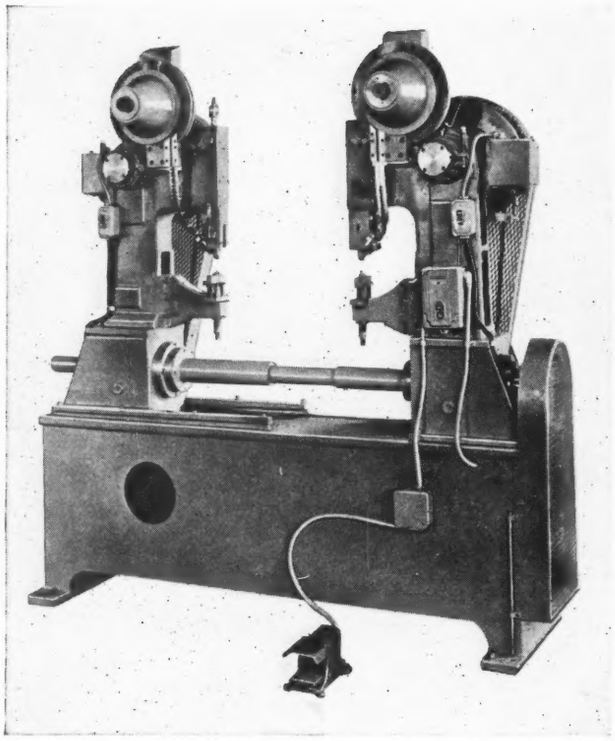
LeMaire Three-Way Twenty-Spindle Drilling Machine

Drilling and other operations on automotive transmission gears are rapidly performed by the use of a three-way, twenty-spindle, hydraulic-feed machine built by the LeMaire Tool & Mfg. Co., Dearborn, Mich. This machine was designed to drill the main 15/16-inch center hole from the solid steel forging in seven steps, and finish each end by spot-facing, counterboring, and grooving. It also drills two 11/32-inch holes through the web at one end of the gear and a 5/16-inch hole across the gear hub.

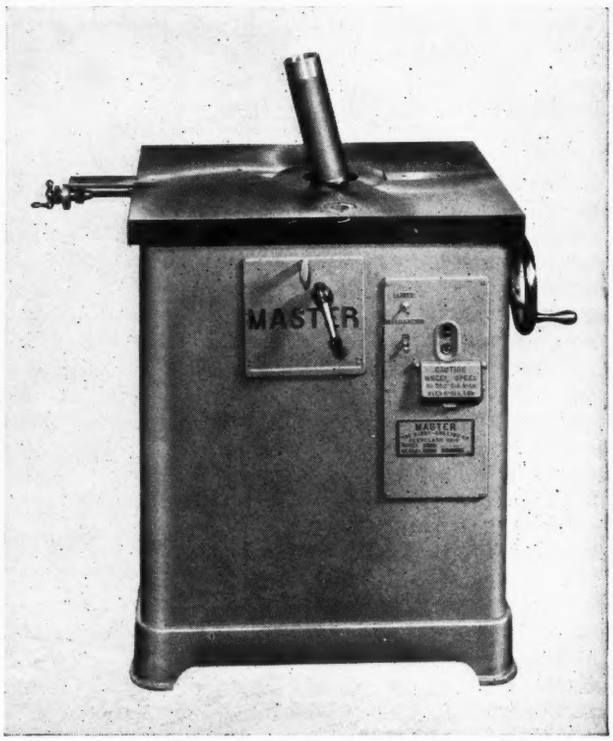
The center base carries the trunnion support, as well as a twin-ram vertical single-spindle



Automatic machine for processing automotive transmission gears, built by Le Maire Tool & Mfg. Co.



Tomkins-Johnson riveting machine which sets two rivets simultaneously



"Master" spindle sander placed on the market by the Kindt-Collins Co.

unit and horizontal right-hand and left-hand units. The right-hand unit has a nine-spindle head, while the left-hand one has a ten-spindle head. The right- and left-hand units have hardened and ground steel ways measuring 30 inches across. The ten-position trunnion is hydraulically operated for automatic indexing, and carries ten work-holding fixtures, which are clamped and unclamped by means of a hydraulic torque wrench.

The entire frame of the machine, including the trunnion support, is of welded steel construction. Production on this machine is approximately 100 pieces per hour. 68

"Dual Rivitor" Designed to Set Two Rivets Simultaneously

A "Dual Rivitor" designed to save time and labor in assembling and riveting operations was recently built by the Tomkins-Johnson Co. for the Allis Chalmers Mfg. Co. This machine was equipped with 10-inch hoppers and tooled to automatically feed and set two wagon box-head rivets at a time in elevator chain assemblies for farm implements. The rivets handled by this machine are 1/4 inch in diameter by 5/8 inch long.

Two 8-inch Model R riveters are mounted face to face on a common base, so that they are adjustable for rivet spacing ranging from 2 1/2 to 18 inches between centers. One motor drives both flywheels, which are synchronized by a combination gear and chain drive arrangement. Both clutches are tripped by solenoids, connected to a foot-switch. 69

Kindt-Collins "Master" Spindle Sander

Several new features are incorporated in the "Master" spindle sander and grinder just announced by the Kindt-Collins Co., Cleveland, Ohio. This machine is said to be the only spindle sander and grinder of its type that has a tilting spindle instead of a tilting table. Thus the part being sanded is always in a horizontal position. The spindle can be used with or without an oscillating movement. It can be tilted at any angle from 0 to 45 degrees by a worm and gear unit, and can be securely locked in position.

The machine is provided with an attachment by means of which straight and tapered core-boxes are produced mechanically, thus eliminating tedious hand work. Other features include a lighted periscope for easy reading of extremely accurate settings; a 2-H.P. motor with choice of 2000 or 4000 R.P.M. speed; abrasive sleeves from 1/4 inch to 4 inches in diameter and 6 to 11 inches long; grinding wheels up to 5 inches in diameter; and built-in safety device which makes it impossible for the high speed to be used with the large diameter units. 70

Traub Single-Spindle Automatic

The E. R. Bachmann Corporation, New York City, is introducing in this country a single-spindle automatic forming, milling, turning, drilling, and cutting-off machine built by the Traub-Maschinenfabrik of Wuerttemberg, Germany. This machine is made up of simple and accessible units, which enables tools and cams to be easily changed for short runs. It can be used to equal advantage on long runs because of its rigidity and stock feeding arrangements. The machine is available in four sizes, with collet capa-

To obtain additional information on equipment described here, use Inquiry Card on page 229.

cities ranging from 19/32 inch to 1 13/32 inches.

Turned parts of all kinds, such as bolts, nuts, bushings, and special pins, can be produced on this machine. It readily lends itself to second operations by the use of a hopper or manually fed magazine attachment. Spindle speeds up to 6500 R.P.M. are available in the smallest size, which is mainly used for the mass production of small precision parts for the watch, instrument, and electrical goods industries.

The second model, with a maximum collet capacity of 13/16 inch, has a maximum spindle speed of 4000 R.P.M. This is used chiefly for machining screw stock and steels of higher tensile strength. The next larger machine, having a maximum collet capacity of 1 inch and a maximum spindle speed of 4000 R.P.M., is especially suited for turning free-cutting materials, such as sulphurized screw stock, brass, aluminum, and plastics. The largest model has twelve spindle speeds ranging up to 2500 R.P.M. and a maximum collet capacity of 1 13/32 inches.

All models can be equipped with a special single-point longitudinal turning attachment, allowing a maximum turning length of 2 3/4 to 3 1/8 inches. All four sizes use B&S standard spindle collets.....71

Clearing Press for Quick Change in Set-Up

Quick and easy adaptation to a great variety of work is the outstanding feature of a new double-action hydraulic press built by the Clearing Machine Corporation, Chicago, Ill. The press has a frame capacity of 1500 tons, the punch slide delivering 1000 tons and the blank-holder slide 500 tons. Maximum stroke of the punch slide is 80 inches, and the press is arranged to draw and lift out a 30-inch piece.

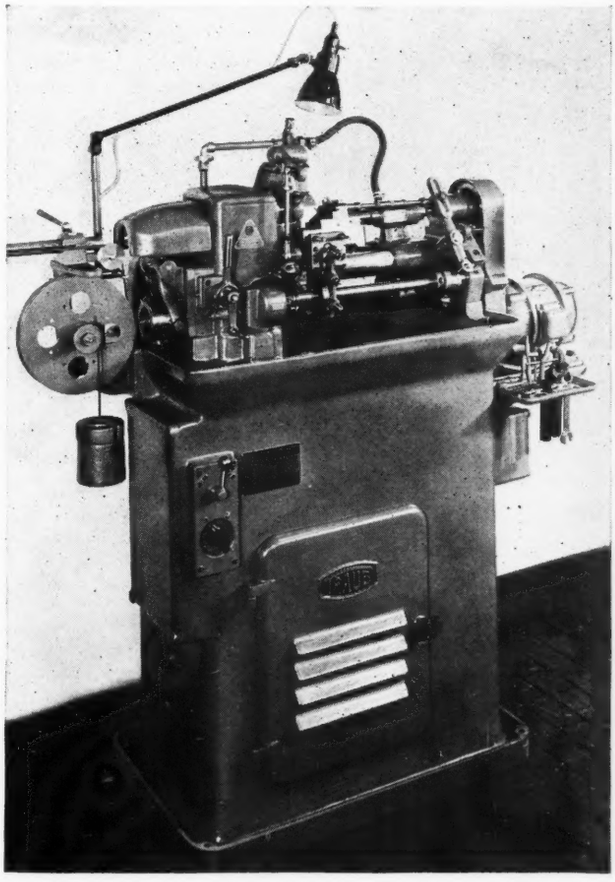
The press bed is 96 inches by 162 inches. An auxiliary filler plate or sub-bolster is supplied, so that minimum shut height may be as little as 20 inches for first-draw or shallow die work. Removal of the auxiliary filler plate increases the minimum shut height to 50 inches.

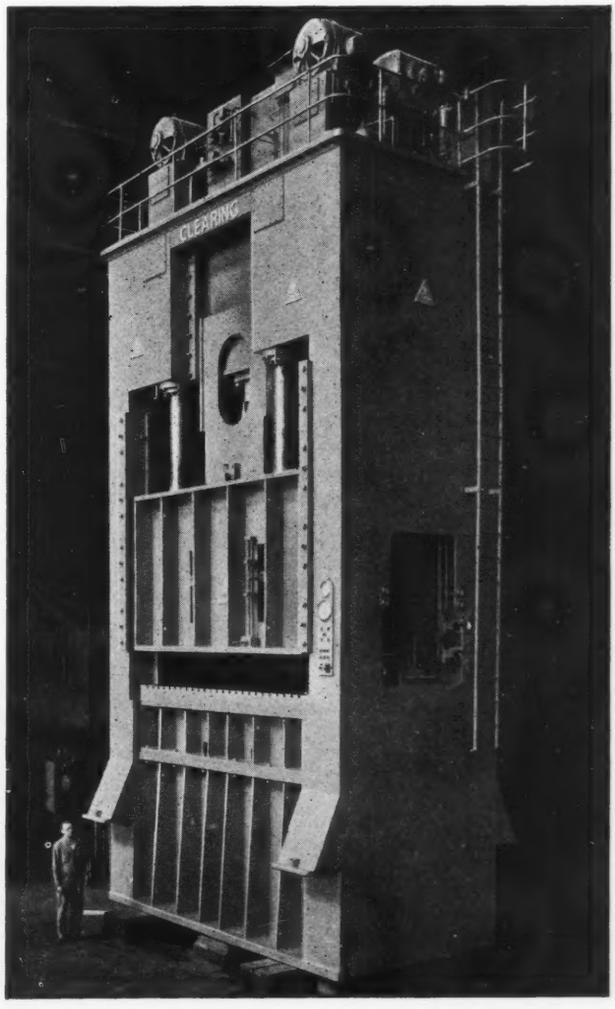
Three pressing speeds are available, in addition to the quick advance and return. Each speed can be used singly in conjunction with the quick advance and return, or any sequence of pressing speeds can be used, so that, in all, seven sequences of automatic operation may be chosen by means of selector switches on the control panel. Selector switches also permit choice of double- or single-action operation, or single-action operation with or without the blank-holder and "inching" control.

Relative positions of the blank-holder and inner slide can be adjusted to suit punches of any length without the need for using packing or blocking behind short punches. Movable lugs at each corner, with an arrangement of spaced keyways, permit adjustment by 2-inch increments. The

(Right) Clearing double-action hydraulic press

(Below) Traub single-spindle automatic introduced in this country by the E. R. Bachmann Corporation





same keyways are used with brackets furnished to tie blankholder and inner slide together for single-action operation without the use of a slide bolster. The press is equipped with three hydro-pneumatic cushions having independent pressure adjustment up to a maximum of 150 tons on each cushion. The cushion stroke is 30 inches.

The press was designed for use in the aircraft industry, where a great variety of work with relatively short runs is encountered. In anticipation of extremely eccentric die loads, the punch slide has been extended to obtain additional guiding in the crown. A greatly increased guiding ratio is obtained through this development, which holds the slide rigidly parallel to the bed under all conditions. Two 200-H.P. motors, mounted on the crown, drive the press. 72

Cincinnati Duplex Vertical "Hydro-Broach" Machines

An improved double-ram vertical "Hydro-Broach" machine announced recently by the Cincinnati Milling Machine Co., Cincinnati, Ohio, is now being built in 5- and 10-ton broaching force capacities, with strokes of 42 or 54 inches and 54 or 66 inches, respectively.

The chief advantage of the improved design is in the table construction. The rams operate alternately up and down, cutting on the down stroke. In front of each ram, an individual table advances to the cutting position and retracts to the loading position in synchronism with the movement of the rams. These tables operate over long square gibbed bearing ways, which are automatically lubricated.

Like other vertical "Hydro-Broach" machines, the tables and rams of the improved machines are actuated hydraulically. Dovetail strips, located in accurately machined slots, clamp the fixtures to the table. The table is exceptionally heavy, and provides ample thickness for drilling and tapping clamping screw holes if they are required.

Protection of the hydraulic pump and valves is provided through fine-mesh intake strainers and a filter, connected in parallel to the hydraulic circuit. When the pressure on the filter reaches a predetermined value, as shown by a gage, the operator knows that the filter is becoming clogged and should be replaced.

In addition to the improvements outlined, preset cycle control—an important safety feature formerly supplied as an attachment—is now included as standard machine equipment. With this unit, the operator can initiate the starting of the next cycle for either ram if he has unloaded and loaded the corresponding fixture while the ram is returning. If he has not completed this job, the ram automatically stops at the top of the stroke, and does not descend until the operator touches the two preset buttons, which serve to keep both hands out of the way of the cutting tools. 73

Safety Electrification Equipment for Overhead Cranes and Tramrail Systems

The Cleveland Tramrail Division, Cleveland Crane & Engineering Co., Wickliffe, Ohio, has an-

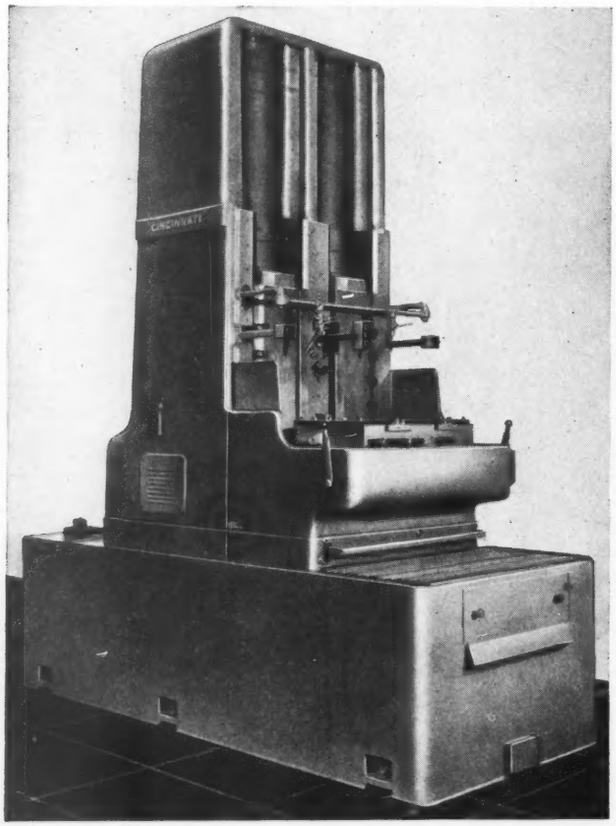


Fig. 1. Duplex vertical "Hydro-Broach" of improved design brought out by Cincinnati Milling Machine Co.

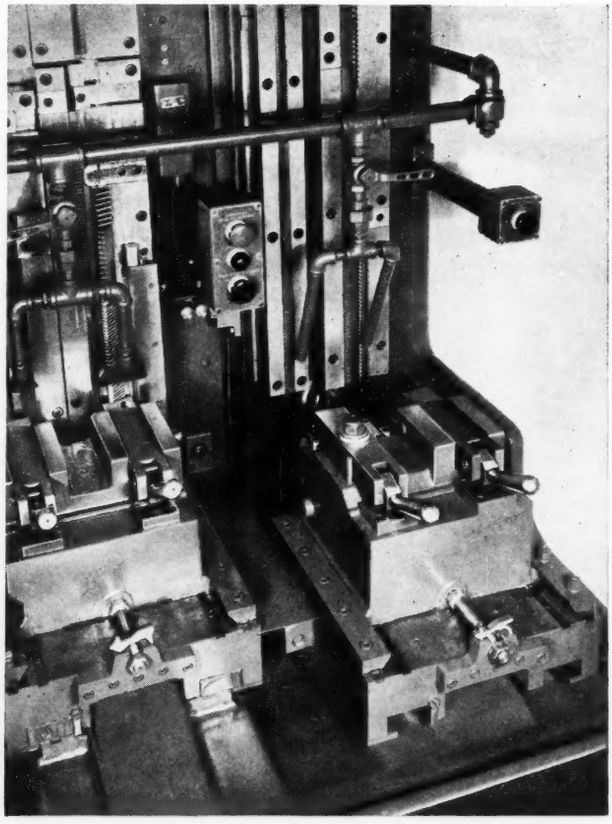
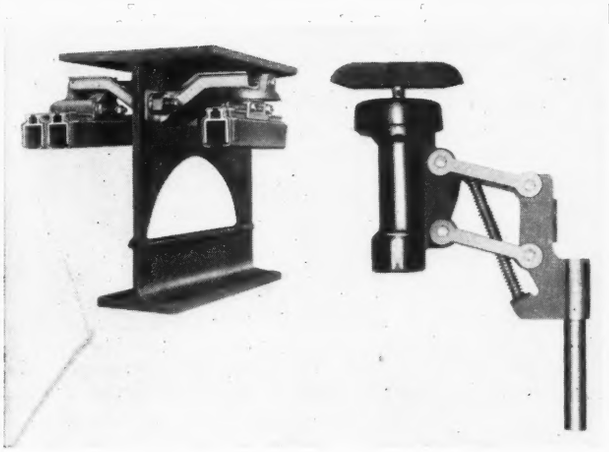


Fig. 2. Close-up view of improved "Hydro-Broach," showing fixtures in broaching and loading positions

To obtain additional information on equipment described here, use Inquiry Card on page 229.



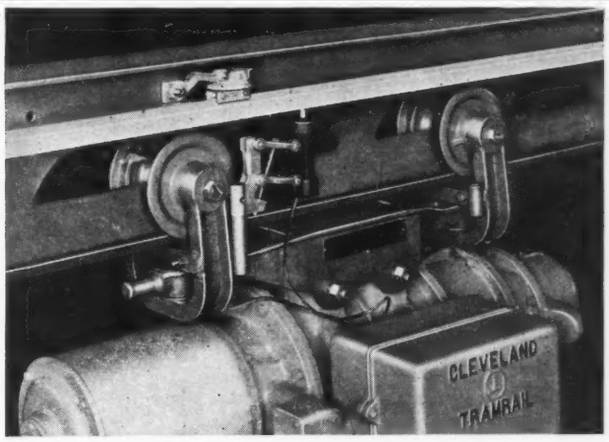


Fig. 1. (Left) Cleveland Tramrail "Saf-Powr-Bars" mounted in position on tramrail track. Fig. 2. (Right) Current collector assembly with sliding "graphitar" shoe which contacts top and two sides of conductor bar

nounced a new type of electrification for overhead cranes and tramrail systems. This equipment is especially designed to provide maximum safety.

The improved equipment, known as the "Cleveland Tramrail Saf-Powr-Bar," consists of inverted U-shaped conductor bars, shown in Fig. 1, inside of which operate sliding current collector shoes, such as shown in the enlarged view at the right. This electrification arrangement can be applied to all new Cleveland tramrail systems, as well as replacements on open-bar electrification. It can also be installed on many hand-propelled systems where motor-powered hoists, carriers, or cranes are now desirable. Shocks and more serious injuries from contact with power bars are prevented because the bar is enclosed with an insulating plastic covering.

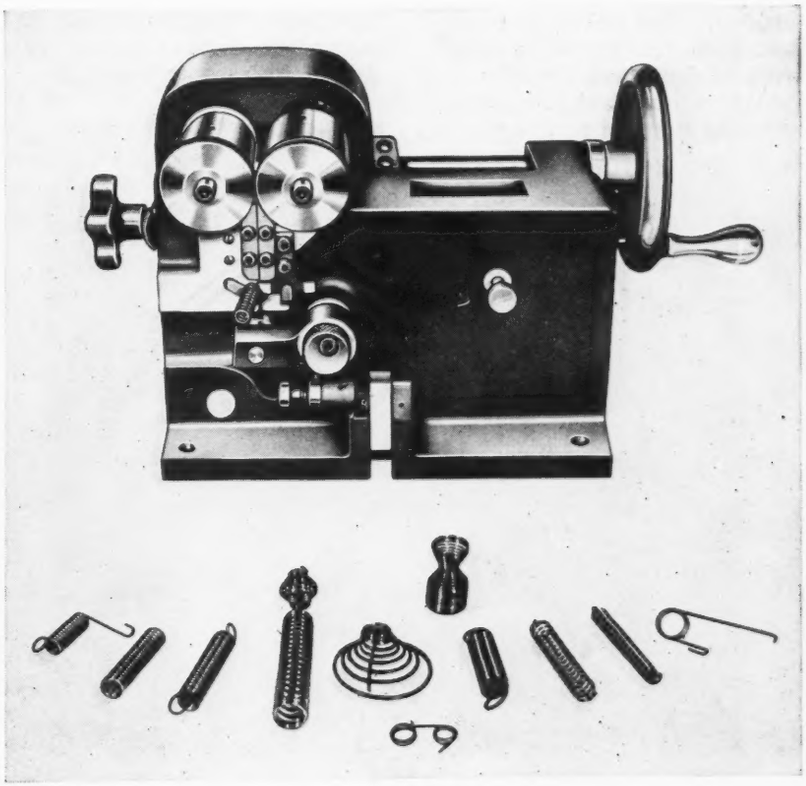
The sliding current collector shoes contact three sides of the bar and operate on a pantographic principle. A diagonal spring provides upward pressure on the "graphitar" shoe, while a torsion spring within a plastic housing causes pressure to be applied on both sides of the conductor bar.—74

Precision Spring Coiler

Torsion, compression, extension, and tapered springs, coiled either right- or left-hand, can be produced with no changing of arbors on a new precision spring coiler manufactured by the Perkins Machine & Gear Co., West Springfield, Mass. This machine will handle wire stock from 0.005 to 0.125 inch in diameter. Springs can be made with or without initial tension and with open or closed ends. When individual or small groups of springs are needed for replacements or experimental work, they can be produced in a matter of minutes.

In operating the coiler, the wire is fed down between two rolls through a guide and into contact with an adjustable grooved point called the "coiling point." The two wire-feed rolls are revolved through gearing by turning the operating handle. The wire is deflected by the coiling point in such a manner as to produce a coil. The raising or lowering of the coiling point by an adjusting screw causes the outside diameter of the coil or spring to be increased or decreased as desired while it is being wound.

Tapered or conical springs can be coiled by turning the screw for adjusting the outside diameter, thus gradually increasing or decreasing the diameter of the coil while the wire is being fed into the machine. The lead or pitch of the spring can be varied by turn-



Spring coiling machine made by Perkins Machine & Gear Co.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

ing another adjusting screw or knob which moves a tool outward from the machine, so that it presses against the spring being coiled and produces the desired spacing between adjacent coils. A separate tool is provided on the machine for forming a loop at the end of the spring.

The equipment includes three wire guides, three feed rolls, and two coiling points. The size of the machine is 8 by 14 inches.....75

Bliss Air Friction Clutch for Continuous Operation of Presses

An air friction clutch capable of twenty-four-hour continuous operation at high speed has recently been developed by the E. W. Bliss Co., Canton, Ohio. This clutch is designed for fast action, positive clutch and brake engagement being achieved through an arrangement of the driving disc in which movement between full engagement and release is only a fraction of an inch.

The self-induced ventilation system is built to assure rapid heat dissipation. The friction plates are arranged to assist the centrifugal blower action, causing a strong current of cooling air to be blown directly on the heated surfaces. The linings are cycle-welded to the plates to obtain more efficient heat transfer and produce a firm bond at maximum operating temperature.

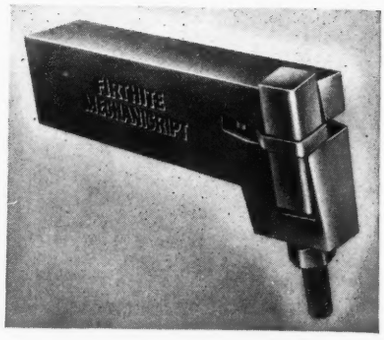
The clutch plates are arranged to automatically compensate for wear. The difference in plate travel with the new friction plates and with worn out plates is less than 1/2 inch. Engagement of the clutch with either new or worn plates is instantaneous. The clutch and brake friction discs float quietly in their mountings and align themselves automatically, thus preventing wear on the friction surfaces by lateral motion. The clutch is specially designed to reduce vibration.

Friction linings for both clutch and brake are mounted on removable insert plates which can be easily replaced without disassembling the clutch. Clutch and brake act as a single unit, preventing overlapping engagement. The brake automatically sets if the power or air pressure fails.

This new clutch, identified as Type K, is made in several sizes, and is now being installed on most medium and large capacity Bliss mechanical presses. A modified design suited for installation on earlier type Bliss presses now in use is also available. 76

Redesigned Carbide-Insert "Mechanigript" Tools

The Firth Sterling Steel & Carbide Corporation, Pittsburgh, Pa., has announced the complete redesign of its carbide-insert "Mechanigript" tools with a view to eliminating chip erosion of the



Firth Sterling redesigned "Mechanigript" tool

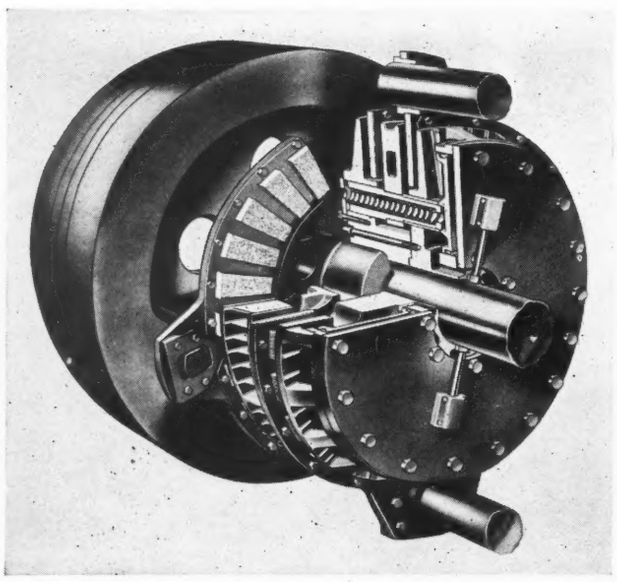
tool shank. A feature of the redesigned tools is open facing of the carbide insert, so that the chips curl against the carbide.

Additional features include top or bottom screw adjustment of the insert. This makes it practical to use either conventional or inverted mounting of the tool, and still have easy access for adjusting the insert as required.

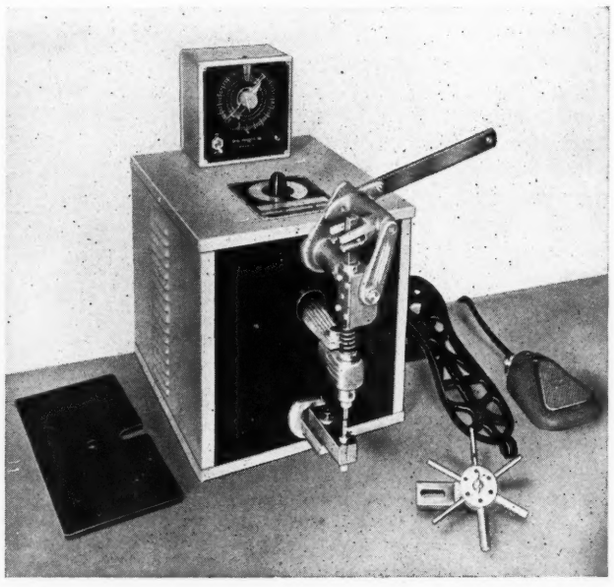
These "Mechanigript" tools are made in ten styles, with seven sizes in each style, for round, triangular, square, or rectangular carbide inserts. The new design shank permits close spacing of the tools for multiple set-ups.....77

Joyal Spot-Welding and Soldering Machine

Joyal Products, Inc., Newark, N. J., has announced a new resistance spot-welding and soldering machine equipped with timer,



Bliss new air friction clutch designed for continuous high-speed operation



Resistance spot-welding and soldering machine brought out by Joyal Products, Inc.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

which is made in 110-volt alternating-current 9-ampere, and 220-volt alternating-current 10-ampere models. This machine is designed to speed up production and reduce costs in the manufacture of instruments, small products, and jewelry. It will perform soldering or welding operations on work of this kind in less than a second. Also, silver soldering, soft soldering, and spot-welding of precious and dissimilar metals can be accomplished. The machine spot-welds steel parts up to 3/32 inch thick, and will solder brass up to 1/8 inch thick, as well as sterling silver and other precious metals.

An automatic cut-off timer regulates the soldering time, and heat control with eleven adjustments determines the correct heat for the job. When dials are set, uniform soldering time, heat, and holding pressure on the electrodes are maintained, regardless of how long the foot-switch is held down. Thus, all chance of work burning and consequent shrinkage is eliminated. 78

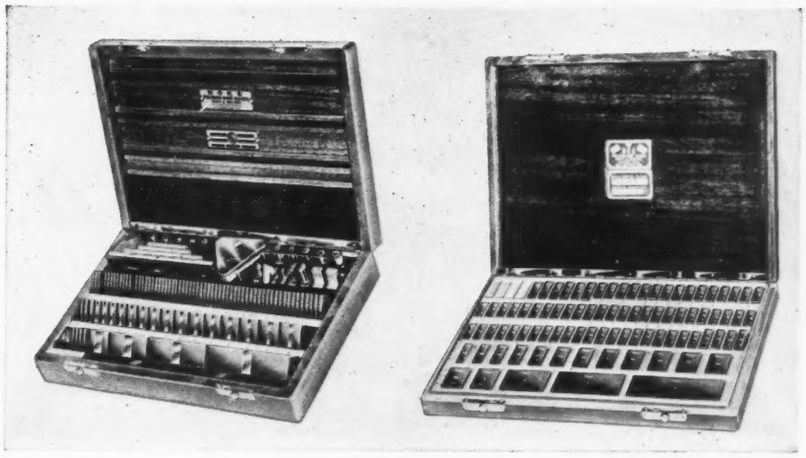
P & W Solid Carbide Precision Gage-Blocks

Solid carbide precision gage-blocks are being added to the line of USA and Hoke steel precision gage-blocks made by the Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn. The solid carbide blocks are furnished in all sizes from 0.050 inch up to and including 4.000 inches. They are sold in sets or individually to replace worn steel blocks, and also as wear blocks in 0.050 inch and 0.100 inch sizes.

The carbide USA rectangular blocks are manufactured to the same high degree of accuracy as the corresponding steel blocks. They conform to the generally accepted dimensions of rectangular gage-blocks.

Carbide Hoke blocks, which are of a square design like the earlier steel blocks of this type, permit the use of internal tie-rods by which rapid, compact assembling of the various attachments is made possible without the use of outside clamps.

Although the initial cost of the carbide blocks is greater than that of steel blocks, their extremely long service life more than offsets the larger investment. Blocks of 1-inch size and smaller are accurate within limits of + 0.000004 and — 0.000002 inch, and sizes over 1 inch are accurate to the same tolerance per inch of length. The measuring surfaces of each block are precision-lapped at 68 degrees F. The carbide gage-blocks have excellent wringing qualities, and are rust- and corrosion-resistant. 79



Solid carbide precision gage-blocks brought out by Pratt & Whitney

Automatic Machine for Spray Painting Small Parts

A newly designed compact, automatic spray painting machine has been developed by the Conforming Matrix Corporation, Toledo, Ohio, for painting small parts on a production basis. The machine is operated entirely by air, with hydraulic control, to eliminate fire hazards introduced by electric motors and switches.

Spraying is done from underneath against masks. This arrangement requires less frequent cleaning of the masks. The surplus spray falls away, and is exhausted from the back of the machine. Electroformed metal masks fit flush with the table, and the parts are loaded manually by the operator, who holds them face down against the mask.

The spraying is done automatically, the length of spray time and the speed of the loading cycle being controlled by dials on the control panel. Means are also provided for regulating the amount of paint sprayed. This flexibility of control is important where a variety of work is handled and where different thicknesses of paint are necessary. Production rates up to 3600 pieces per hour are possible. 80

Machine developed by Conforming Matrix Corporation for automatic spray painting of small parts

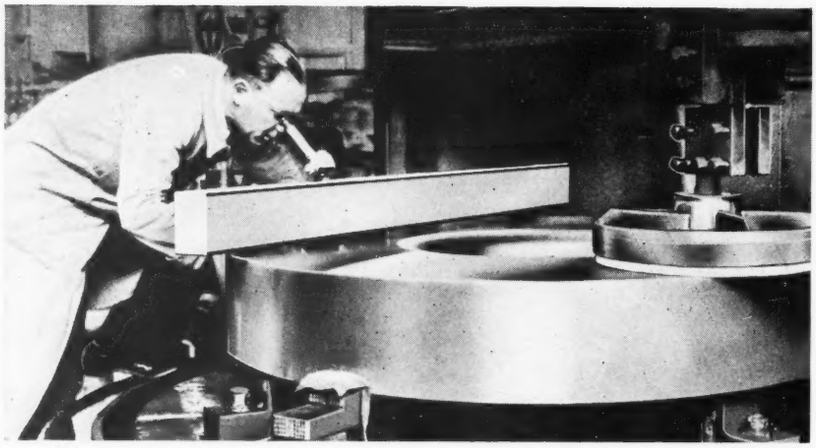
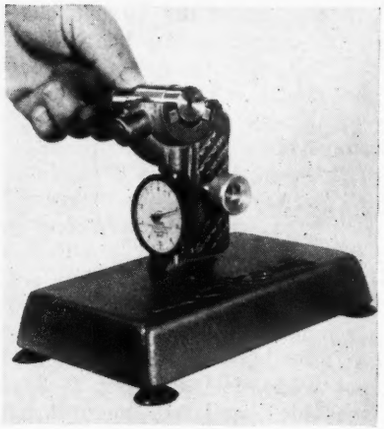


Fig. 1. Griswold Huet "optical straightedge" brought out by the F. T. Griswold Mfg. Co.



Precision comparator gage made by Troy Precision Tool Co.

"Optical Straightedge" Designed to Simplify Contour Measuring of Large Flat Surfaces

By utilizing a beam of light as a straight-line reference, inaccuracies in flat surfaces as small as plus or minus 0.00005 inch can be measured with the new Griswold Huet "optical straightedge" announced by the F. T. Griswold Mfg. Co., Wayne, Pa. This precision measuring device consists of a lens and prism housing and a "feeler" microscope with built-in illumination unit, which rides along the surface being examined, as indicated diagrammatically in Fig. 2.

The housing is made in standard lengths of approximately 3, 5, 10, and 13 feet, and rests on two blocks. The feeler, which includes the optical system, slides on the work surfaces. The errors observed through the microscope are indicated by the relative position of two indices. The distance between these indices is converted into linear measurement by reference to the graduations on the micrometer thimble.

A graphic record of the surface contours can be made by accessories attached to the equipment. Deviations enlarged 1000 times are traced for a permanent record on coordinate paper as the feeler is moved from one end of the housing to the other. The optical straightedge thus makes possible quick and accurate checking of surface deviations in surface plates, machine tool tables, slideways, cylinders, flat beds, and other parts. ----------81

Troy Comparator for Precision Checking of Diameter and Roundness

A new three-point controlled-accuracy comparator gage available in sizes for a wide range of diameter inspection operations is being made by the Troy Precision Tool Co., Welshfield, Ohio. This gage has three contact points that are so located that the mere rotation of a shaft on the gage automatically inspects the piece for out-of-round characteristics or "clover leaf" within limits of 0.0000250 inch. This new Series AO open comparator type gage is available in twenty-one sizes covering a range from 3/8 to 3/4 inch in 3/16-inch increments, and from 3/4 inch to 6 inches in increments of 1/4 inch.

Each gage is adjustable within its range, and can be set by means of hardened, ground, and lapped masters made to meet any desired class of tolerance requirements. The cemented-carbide inserts utilized in these gages are ground and lapped to gage-block parallel, and are re-workable for the life of the carbide. Sapphire-tipped inserts can also be supplied for use on highly abrasive or soft, easily marred materials.

The gages are normally supplied with Federal dial indicators, but they can be furnished without dial indicators when specified.--82

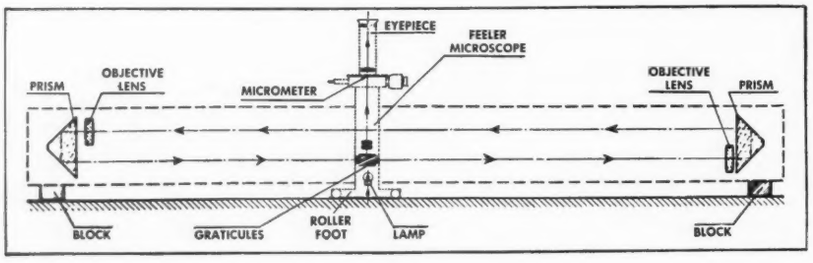


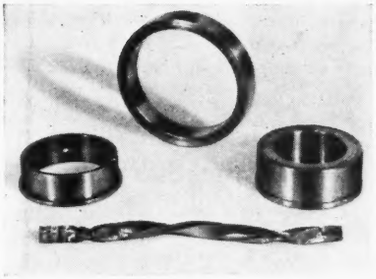
Fig. 2. Diagram illustrating operating principle of "optical straightedge" shown in Fig. 1

Bronze Steel-Backed Bearings

Bronze steel-backed bearings designed to combine strength and lightness have been introduced by Beauideal, Inc., Saginaw, Mich. These bearings are adapted for heavy-duty applications, especially where extremes of temperature are encountered. They are produced by a new non-mechanical bonding process which causes the bronze of the bearing to adhere firmly to the steel backing. Test pieces cut from these bearings which were straightened and then twisted until they broke showed no indication of a separation between the bronze and the steel.

Bearings using a steel such as Nitralloy combined with a high leaded bronze can be heat-treated to a temperature of 1100 to 1200 degrees F. When a long-grain

To obtain additional information on equipment described here, use Inquiry Card on page 229.



Bronze steel-backed bearings introduced by Beauideal, Inc.

bronze is used, processing can be accomplished at from 1500 to 1600 degrees F.

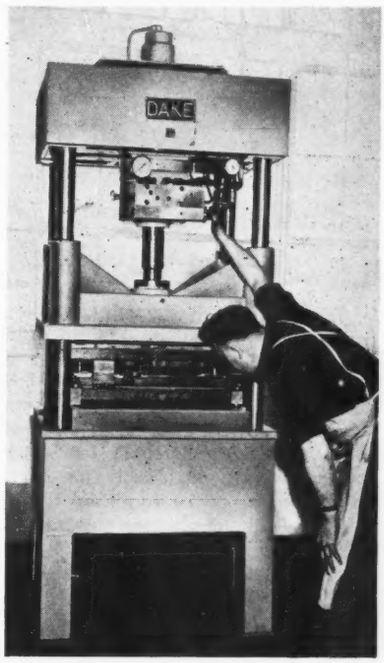
The bearing at the center of the illustration and the drilled thrust bearing at the left have bronze outer surfaces, while the bearing at the right has a bronze inner surface. The twisted test piece shown in the foreground illustrates the close bond between steel and bronze. 83

Dake Presses for Die Try-Out and Limited Production Work

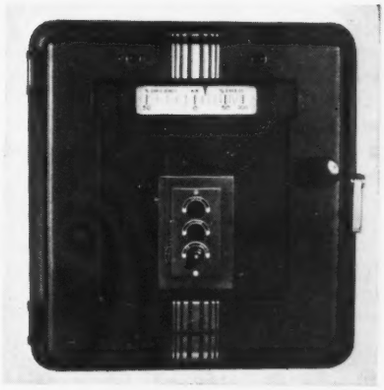
A new series of hydraulic presses especially designed for use in die matching, to avoid tying up production equipment, has been brought out by the Dake Engine Co., Grand Haven, Mich. These presses can also be used for short production runs.

The new line includes both single- and double-acting presses in capacities ranging from 25 to 125 tons. All models are actuated by a simple hydraulic mechanism, which is operated either by electric motor or by an air cylinder designed to attain maximum power and speed at air pressure of 90 or 145 pounds per square inch.

The single-acting models are power-driven on the up stroke and returned to the starting position by gravity. Double-acting models are power-driven on both up and down strokes, and are provided with a rapid advance mechanism which operates until the press is brought under load, automatically changing to power advance for the remainder of the stroke.....84



Die try-out and limited production press manufactured by the Dake Engine Co.



L & N air-fuel ratio controller

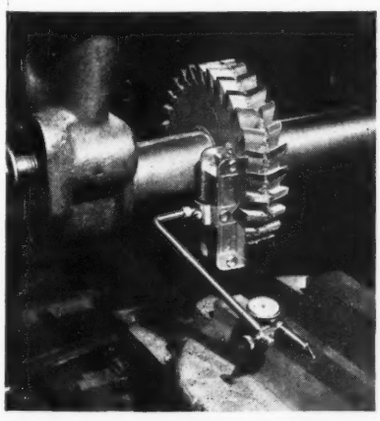
Leeds & Northrup Air-Fuel Ratio Controller

An air-fuel ratio controller designed for quick response in adjusting air flow to fuel flow changes without cycling is a recent product of Leeds & Northrup Co., Philadelphia, Pa. Applicable to oil or gas firing, or to dual-fuel furnaces, it meters both fuel and air flow for maximum accuracy of control. The instrument is available for control of temperature, draft, and combustion of large fuel-fired furnaces and kilns.

Models are supplied to operate an electric or a pneumatic control valve. Added speed and sensitivity are obtained, with full stability, through the use of an improved control circuit. The ratio range extends from 50 per cent deficiency to 100 per cent excess air. Direct remote control of air flow and transfer from manual to automatic control are provided on the front of the instrument.....85

Magnetic Indicator Holder

Erick "Magna-Holder" for all types of indicators. Designed to save the time usually required to check and set up conventional indicator holders. Can be applied to flat, round, or angular-shaped ferrous surfaces. Permanent Alnico magnets hold with a pull of 30 to 35 pounds. Universal settings and direct indicator readings are made possible by a non-magnetic stainless-steel indicator holder arm set in a ball socket. Introduced by Passing Eye, Incorporated, Kenosha, Wis. 86



Bantam Size Filterless Dust Collector with Outdoors Exhaust

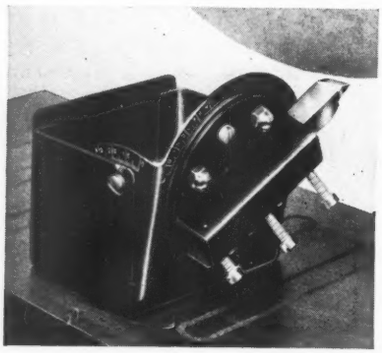
Small size dust collector especially intended for use where remotely located dust sources having toxic fumes, vapors, or obnoxious odors are to be exhausted outdoors. While requiring only 12 by 23 inches floor space, the unit develops a rated capacity of 437 cubic feet per minute and a velocity of 5000 feet per minute at the inlet. This amount of suction is adequate to handle a buffing,

To obtain additional information on equipment described here, use Inquiry Card on page 229.

polishing, or grinding wheel up to 10 inches in diameter, or two wheels for similar work from 3 to 7 inches in diameter. Can also be used for sanding operations with belt or disc sander on rubber or synthetic products. The unit has a 1/3-H.P., 3600-R.P.M. continuous-duty motor with direct drive to a self-clearing paddle-wheel type fan. The motor is designed for operation on 110-volt, single-phase, 60-cycle power. Announced by Aget-Detroit Co., Ann Arbor, Mich. 87

Tool Grinding Holder with Angular Adjustments for Clearance and Rake

New "AccrAngle" grinder attachment, which makes possible the grinding of cutting tools, threading tools, box-tools,



or single-point tools having any angle of rake or clearance without removing the tool from the holder. Holds tools up to 1/2 inch in size. Manufactured by Carl Nomann Co. Los Angeles, Calif. 88

Hoffman Oil Conditioning Unit

Small batches of used hydraulic, lubricating, run-in transformer, and other oils can be restored to their original condition with this new oil conditioner, which has a capacity of 25 to 40 gallons per hour. The unit consists of a cartridge filter and vaporizer, with all necessary electric and pump connections. It is manufactured by the U. S. Hoffman Machinery Corporation, Syracuse, N. Y. 89

Lundahl Set-Up Kit

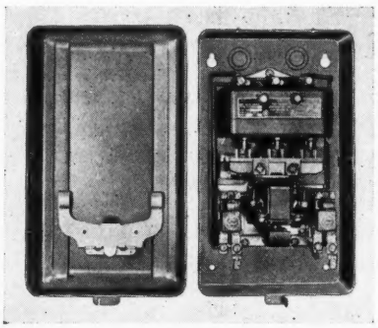
Set-up kit designed by Lundahl Corporation, Hartford, Conn., to save time and expense in preparing spring-making machines for production. The kit comprises a mahogany cabinet containing a tray with a complete set of carbide tools in regular graduations. These tools cover the standard size range of the spring-making machine for which the kit is designed. Tools for oversize diameters can be furnished on request. The cabinet also contains a high-speed grinder fitted with a 4 1/2-inch diamond wheel and a 4 1/2-inch silicon-carbide grinding wheel. 90

Colmony "Spraywelder"

New model "Spraywelder" powder metallizing unit brought out by the Wall Colmonoy Corporation, Detroit, Mich. The Sprayweld process consists of applying uniform overlays of Colmonoy hard-facing alloys, using metallizing procedures, and then subsequently bonding the overlay to the base metal. The "Spraywelder" can also be used to apply other powdered metals. 91

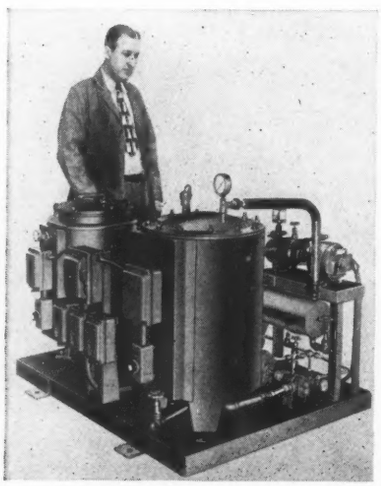
Clark Alternating-Current Motor Starter

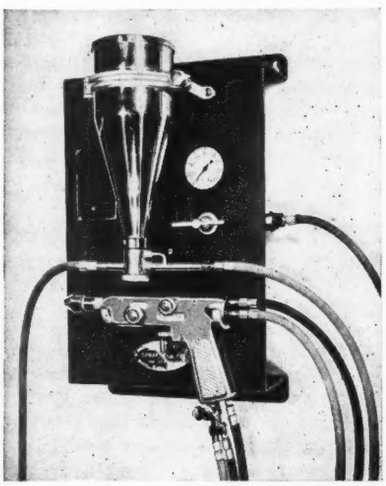
Starter for alternating-current motors with new arc interrupting principle, announced by the Clark Controller Co., Cleveland, Ohio. The new feature of this CY-2 starter is the combined use of strong multi-turn magnetic blow-outs with twin break contacts. The action of the blow-outs assures that any arcing that occurs will be spread uniformly over the entire contact surfaces, thus minimizing burning and pitting of contacts. The starter is of rugged mill type design, with standard NEMA mounting dimensions. 92

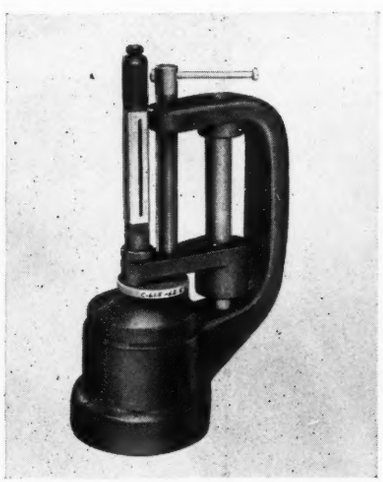


"Metalometer" with Peabody Anvil for Surface Hardness Testing

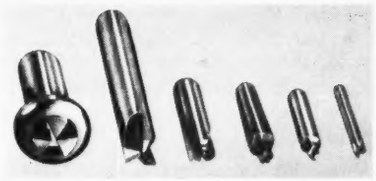
New model "Metalometer" with Peabody anvil attachment, developed by Peabody Industries, Inc. Highland Park, Mich. New features include tungsten point, micro interior finishes, and trigger release mechanism. The Peabody anvil broadens the field of application for testing the surface hardness of small parts. Sheet steel, gears, castings, tool bits, drills, etc., can be accurately checked for hardness. 93







To obtain additional information on equipment described here, use Inquiry Card on page 229.

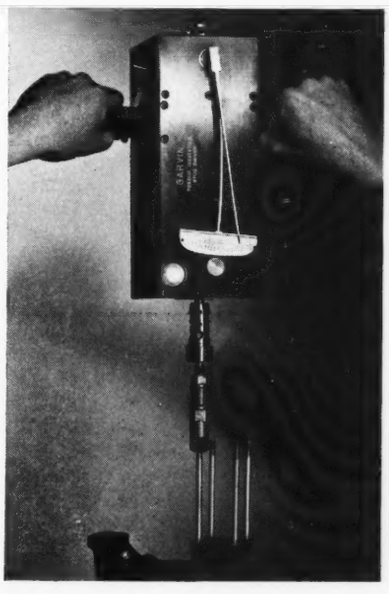


Small Size Precision Hollow-Mills

Especially designed small hollow-mills, of extreme precision, made in sizes up to 5/8 inch in diameter by Woodruff & Stokes Co., Hingham, Mass. These hollow-mills are manufactured to meet specific customer requirements. They are machined from carbon or high-speed steels or special steel alloys, and include plain or adjustable types, with internal or external steps, for left-hand or right-hand screw machine work. Each tool is specially heat-treated to give long life, and is made to tolerances required by the customer's needs. 94

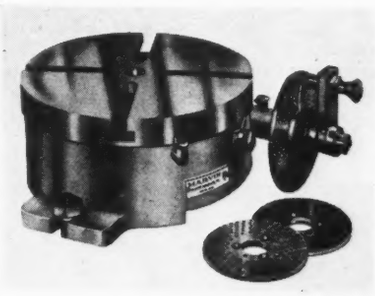
Garvin Torque-Indicating Driver

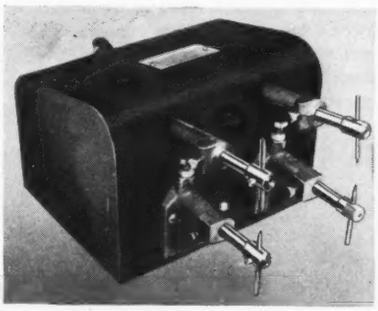
New Garvin torque-indicating driver made by Tru-Circle Products Co., South Bend, Ind. This driver is designed to positively and automatically measure the torque as it drives studs, nuts, screws, or fasteners. It is said to give a precise torque measurement and to eliminate stud breakage, as well as reduce scrap loss. Maximum torque is indicated by a standard deflection type torque wrench and by a red light. Can be furnished with a relay that interrupts the power source and automatically stops rotation when the desired torque is reached. Adjustments for both high and low torque limits are easily and quickly made. The driver is made in six capacities ranging from 0 to 100 up to 0 to 2000 inch-pounds. Special drivers are available with snap-on attachments for quick change of wrenches in nut "running" to close torque tolerances. 95



Marvin Rotary Table

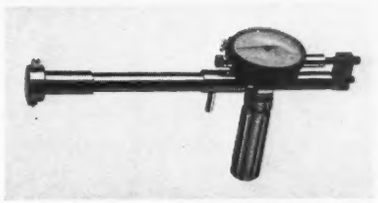
Rotary table specifically adapted for defense work now being produced by Marvin Machine Products, Inc., Detroit, Mich. This rotary table is extremely rigid and especially proportioned for use on bench miller, shaper, or drill press. It is furnished with three index-plates, each of which has six circles of holes, which gives a wide range of divisions. The table is locked from the center, giving assurance against tilting. A large cast-iron wormwheel meshes with a 40 to 1 hardened and ground worm, which can be disengaged. The rotary table is 2 5/8 inches high and 6 1/4 inches in diameter. 96





Bench Welding Head with Double Set of Electrodes

New double-head bench welding unit recently added to the line of electric welding equipment with "Tweezer-Weld" action made by the Federal Tool Engineering Co., Newark, N. J. The tweezer pressure is applied through a cam acting against the variable deflection of a cantilever spring. This combination of cam and cantilever spring action automatically provides follow-through pressure instantaneously. Independent switches for each pair of electrodes are provided. The electrode pressure is variable from 6 ounces to 15 pounds by micrometer-like adjustment. 97

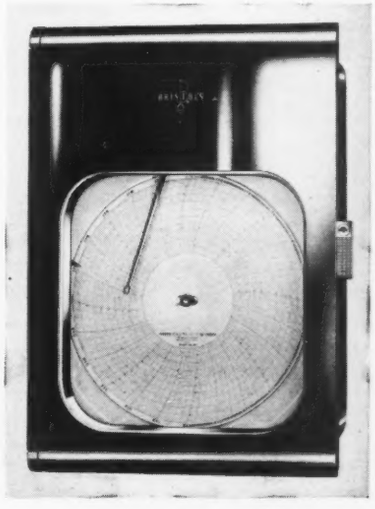


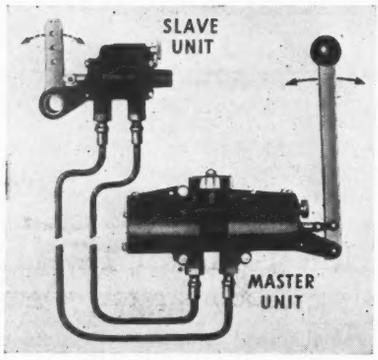
Rimat Internal Thread Comparator

Internal thread comparator designed to accurately measure the distance from the pitch line of any one thread in a nut to the pitch line of the two threads lying diametrically opposite. When set to a basic ring gage, it gives plus or minus deviation readings from the basic pitch. The indicator has 0.0001-inch graduations and a range of plus or minus 0.003 inch for any one setting. It can be set to a ring gage in a few seconds. These comparators are available for measuring National Coarse threads in sizes from 1/2 inch to 4 inches in diameter and National Fine threads from 1/2 inch to 1 1/2 inches in diameter. They are manufactured by the Rimat Machine Tool Co., Glendale, Calif. 98

Bristol Running-Time Recorder

Running-time recorder announced by the Bristol Co., Waterbury 20, Conn. This instrument records on a chart the operating or "on" time of production machinery and similar equipment. The chart record gives the total "on" time in hours, minutes, and seconds for a given period. "Time off" periods are also shown on the chart, as well as the time at which they occurred. With this recorder, total operating time of a machine can be easily and accurately determined to within a few seconds. The instrument is furnished in models that are suitable for wall, flush-panel, or portable use. 99





Superdraulic Remote Control

Hydraulic remote control system now being offered by Superdraulic Corporation, Detroit, Mich. It consists of a master unit and a slave unit, interconnected by two small tubes. Motion applied to the actuating lever of the master unit is accurately duplicated by the lever of the slave unit. The control has positive load carrying ability in both directions, and although small and compact, is capable of handling a torque of 500 inch-pounds for applications ranging from steel mills and machine tools to aircraft controls. 100

Jaco Horizontal Stock Reel

Horizontal stock reel for punch presses which requires no power and is designed to eliminate lost time due to "hitch" or roll feed interruptions. In order to overcome the "snatching" action of coiled stock often experienced, provision has been made for uncoiling the stock from a horizontal position on a ball-bearing mounted turntable. The freely rotating reel is propelled by the natural spring of the material, which develops torque as it uncoils, thus maintaining automatically the exact feed required by the press tool. Product of Jaco Devices, Inc., Hingham, Mass. 101

Immersion Thermo-Couple Pyrometer for Measuring Steel Bath Temperatures

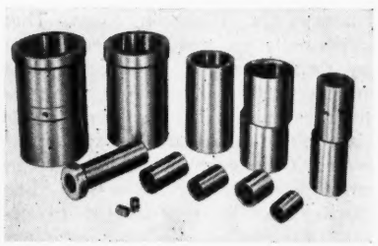
The immersion thermo-couple equipment illustrated, which has just been announced by the Leeds & Northrup Co., Philadelphia, Pa., is said to offer exceptional operating convenience. It consists of a platinum-platinum 10 per cent rhodium immersion couple and a "Speedomax" pyrometer with special signalling features, which include green, amber, and red signal lights. The thermo-couple is mounted in a refractory-protected tube, and is supplied in lengths of 5 to 12 feet. The "Speedomax" range of 2400 to 3200 degrees F. spans the steel temperature range usually required. A separate section at the left edge of the chart covers 0 to 200 degrees F., affording a ready check on room temperature, which shows the condition of the thermo-couple. 102

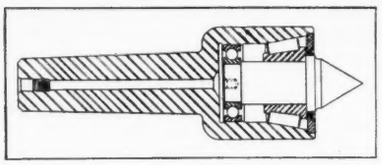
Electrically Driven Hand-Operated Hacksaw and Drill

"Trade Master" combination hacksaw and drill brought out by the P & L Products Co., Greenville, Ohio. Can be converted from a drill to a saw by simply flipping a button. When operated as a saw, either regular hacksaw blades or blades prepared for any specific material or work by the manufacturer can be used. When operated as a drill, the saw guide is turned down out of the way. Will accommodate drills up to 1/4 inch size. A "flex" sander can be substituted for the saw, and a file can be inserted to permit use as a filing machine when rigidly supported. 103

Improved Bronze Bearings

Bronze bearings and bushings of greatly enlarged and improved line just announced by Bronze Bearings, Inc., Cranford, N. J. These bearings range from very small sizes up to 24 inches in diameter. The line includes plain, flanged, and split types or combinations of these types. Finishes ranging from an accurate machine finish for precision applications to a semi-finish for rough work are now available. 104





Self-Adjusting "Free Center"

Work-supporting center that automatically adjusts itself for wear and is said to never get loose or wobble. It is designed to permit the end thrust from the work to keep the tapered roller bearing perfectly seated, thus maintaining accuracy at all times. This new "Perfection free center," as it is called, is recommended for precision work performed on grinders and lathes. Announced by Mechanical Development Corporation, Pittsburgh, Pa. 105

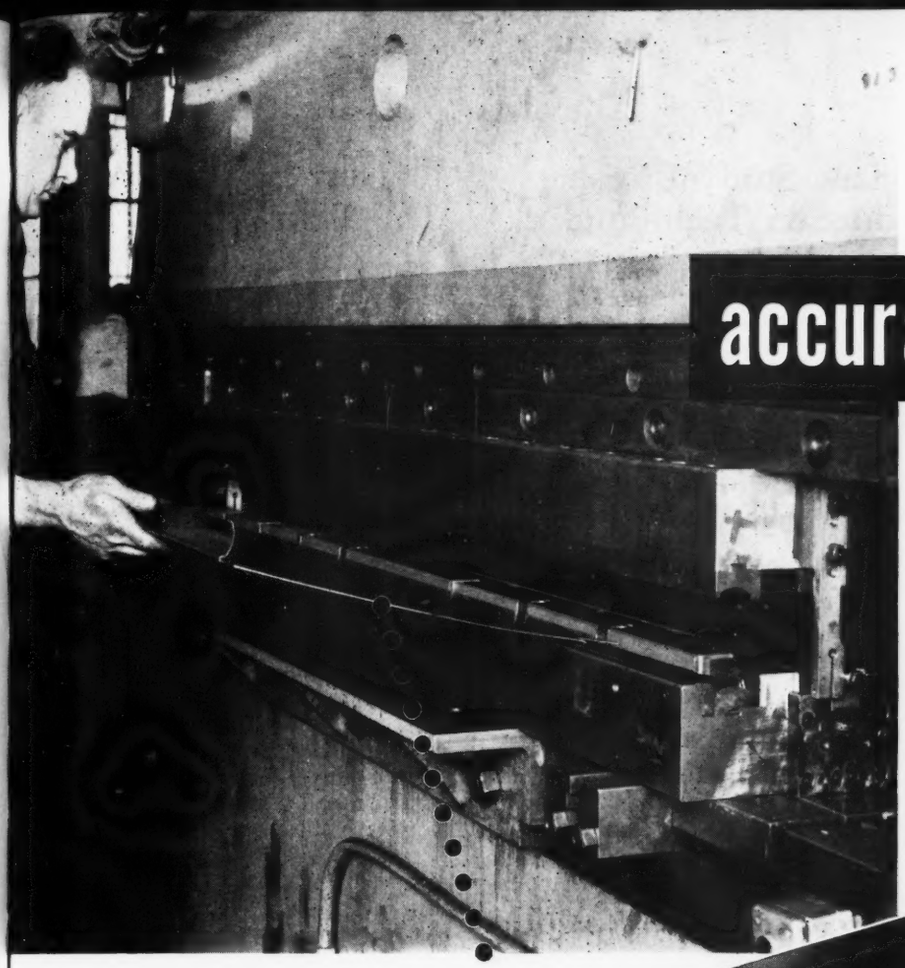
* * *

A 50 per cent increase in wages is being enjoyed by the workers in the new mechanized wheel plant of the Osborn Foundry and Engineering Co., Ltd., of Sheffield, England, whose managing director, Frank A. Martin, was chairman of the first team of Europeans who came to the United States under the Marshall Plan Technical Assistance Program. It is stated that improvements based on American techniques have resulted in a production that matches the best in the United States.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

accurate forming

on a Cincinnati solved this problem



lote the clean, straight lines of the moldings rmed on the shelf by this Cincinnati Press Brake.

These outstanding sectional Bulman display shelves fit accurately.
Photo courtesy E. O. Bulman Mfg. Co., Inc., Grand Rapids 2, Michigan.

Accurate forming paid off in three ways for Bulman Company, manufacturers of steel display shelves.

Trouble had been experienced in maintaining regularity of product. Now the clean, straight line formed from end to end of the shelving permits a perfect match-up of sections, eliminating a costly trim piece.

Better product, with no discards, and one piece completely eliminated, were the results when this Cincinnati Press Brake was installed . . . it was a profitable investment.

Write for Catalog B-2A—a Cincinnati Press Brake may improve your product and reduce your costs.

THE CINCINNATI SHAPER CO.
CINCINNATI 25, OHIO U.S.A.
SHAPERS · SHEARS · BRAKES

CINCINNATI

American Technicians Study British Pressed-Metal Production Technique

Many groups of British technicians have visited the United States under the auspices of the Anglo-American Council on Productivity in order to study technique in this country and to report back to their respective industries. So successful has this activity been that it is now becoming reciprocal in that American groups are being sent to study British technique.

The second such group from America recently arrived in Britain, and will study pressed-metal production in such works as Pressed Steel Co. Ltd., Briggs Motor Bodies Ltd., Vauxhall Motors Ltd., Nuffield Metal Products Ltd., and Fisher & Ludlow Ltd. There were sixteen Americans in the group, among whom may be mentioned F. C. Greenhill, president of the Acklin Stamping Co., Toledo, Ohio; O. B. Werntz, managing director, Pressed Metal Institute, Cleveland, Ohio; T. L. Baker, vice-president of the National Stamping Co., Detroit, Mich.; W. G. Jeschke, president of the Res Mfg. Co., Milwaukee, Wis.; J. M. Leake, president of the Leake Stamping Co., Monroe, Mich.; and W. F. Baird, superintendent of the Toledo Pressed Steel Co., Toledo.

In view of the urgency of production for export markets and the rearmament program, the exchanges of view effected between British and U. S. technicians should be of great importance.

Extruded Protective Coating Applied to Metal Tubes

A new service for plants using instrument tubing or fluid transmission lines subject to moisture or corrosive atmospheres is announced by Samuel Moore & Co., Mantua, Ohio. A protective coating of vinyl or polyethylene is extruded over the tubing by means of the patented "Dekoron" process in the company's plant prior to installing the tubing in the customer's shop.

The thick plastic armor sheath, which can be extruded over steel, copper, or aluminum, is chipproof, and renders the metal tube virtually impervious to moisture, salt air, acids, and alkalies, or corrosive atmospheres.

Tubing ranging from approximately 1/8 inch up to more than 3 inches in diameter can be coated by this process, and the thickness can be varied from 0.015 inch to practically any thickness required by service conditions. The coating can be applied to straight lengths of tubing or to 50-foot coils.

New Finish for Magnesium

The Army Ordnance Corps has announced recently a new finish for magnesium and magnesium alloys. It is known as HAE in honor of its discoverer, H. A. Evangelides, an electro-chemist in the Pitman Dunn Laboratory at Frankford Arsenal.

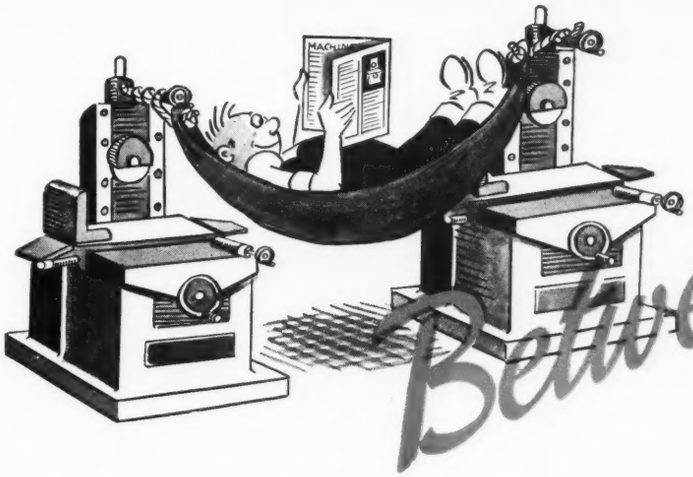
The outstanding characteristics of HAE are its excellent corrosion resistance, high melting point, good dielectric strength, and hardness. It normally has a brown color of varying shades, and is an excellent paint base.

The new finish can be applied to any of the commercial magnesium alloys—wrought or cast—including the magnesium-zinc-zirconium alloy ZK-60. It is applied electrolytically, much the same as aluminum alloys are anodized. The electrolyte is compatible with magnesium; in other words, it is safe to apply the coating to magnesium castings without danger of entrapped electrolyte corroding the metal. The bond between the HAE coating and the magnesium is strongly adherent.

* * *

Exports of motor vehicles during the first quarter of 1951 totaled 126,644 units, an increase of 118 per cent over the comparable period of last year. This was 6 per cent of the total output.

Visitors being greeted at the Open House recently held at the new Cincinnati steel service plant of Joseph T. Ryerson & Son, Inc., which was attended by about 3500 people. Center, in dark suit with hand outstretched, is Anthony M. Ryerson, great grandson of the founder of the Ryerson company. Immediately behind him and slightly at left is Earl R. Nelson, manager of the Cincinnati plant. In back row, (top right) from right to left, is Everett D. Graff, in dark suit, chairman of the executive committee; slightly facing Mr. Graff and smiling is Harold B. Ressler, first vice-president; and at Mr. Ressler's right is W. F. Kurfess, manager of the Ryerson plant in Milwaukee, Wis.



Between Grinds

By E. S. Salichs

Swaps His Figures

A buyer of our MACHINERY'S HANDBOOK and "Use of Handbook Tables and Formulas" informed us in his letter ordering them: "I am a sculptor, doing industrial work for the Wright Aeronautical Corporation, and believe these books will be helpful to me."

Crunch the Brunch

General Electric scientists are conducting experiments to make sawdust a practical food for cattle. Irradiation with high-voltage electrons, or cathode rays, makes part of the sawdust digestible by organisms in the cow's stomach. In Europe, sawdust is given a sulphuric acid treatment, but it is believed that irradiation may prove simpler and less expensive. What's that famous line—we'd rather see a cow than be one?

Time and Tide

It's most invigorating to inhale sea air unless you happen to be a clock, is the experience of the Colgate clock, world's largest, which dominates New York Harbor. So a job to combat corrosion was done on it, according to "Steel Horizons," involving the use of 3/8 mile of stainless steel slats and 2100 stainless screws. The clock now ticks us that its minute hand travels 31 inches every minute, or 155 feet around in its hourly tour, without a wheeze in the watchload.

Monkey is Moniker

The term "monkey wrench" is quite misleading, for if you give it any thought at all you may wonder how a simian got involved with a wrench; in truth, it is derived from its inventor, Charles Moncky, who patented the wrench many years ago.

Calling Competitors

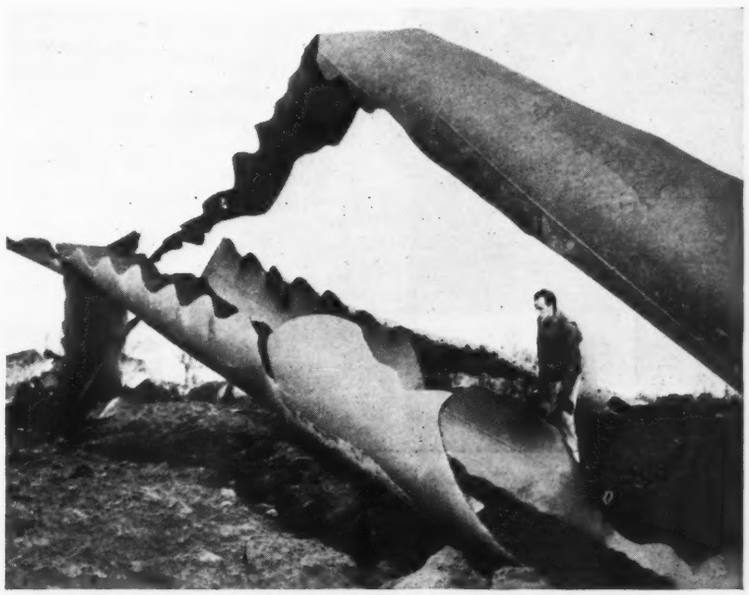
NOW is the time to be mulling over bright ideas for your entry or entries in MACHINERY'S Ingenious Mechanisms Contest, and get them to us in good shape by land, sea, or air before November 1. Eight winners will share $500, checks to be in the mail before Christmas — gravy for the turkey as it were. (See July MACHINERY, page 209.)

Gaging the Gift

"Best machinist" of graduating class of Williamson Free School of Mechanical Trades, Delaware County, Pa., was presented with a subscription to MACHINERY by the school's Alumni Association—John M. Heibeck the lucky man.

And the Riders Don't Get Dizzy

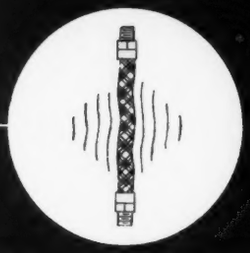
In the German language, a vertical boring mill is called a Karussel-Drehbanke. But there are no wooden horses, no rings to snatch, no canned music. Just the usual boring mill with a revolving table.



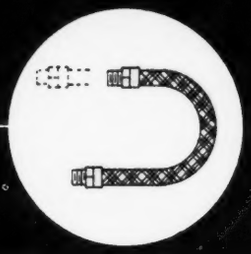
THE WELD HELD—Not a prehistoric monster about to swallow up homo sapiens, but a mile of 30-inch pipeline which exploded. The seams held while the plate tore apart. This unexpected test of welding strength interested the Lincoln Electric Co. no end, although it was the pipe's

Titeflex

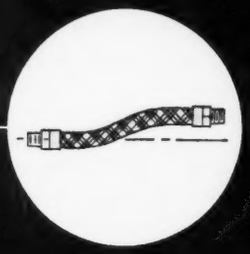
ALL-METAL FLEXIBLE TUBING



FOR VIBRATION



FOR FLEXING



FOR MISALIGNMENT

You can't beat Titeflex for conveying liquids, gases or semi-solids when there is any kind of motion present. Here are the facts about this better-built flexible tubing:

- ★ Made in five metals—brass, bronze, stainless, Monel, Inconel.
- ★ Types and sizes to withstand heat to 1550°F.
- ★ Types and sizes for pressures up to 6800 psi.
- ★ Supplied with any type of fittings—standard or special.
- ★ Stays flexible and stays tight under severe conditions.

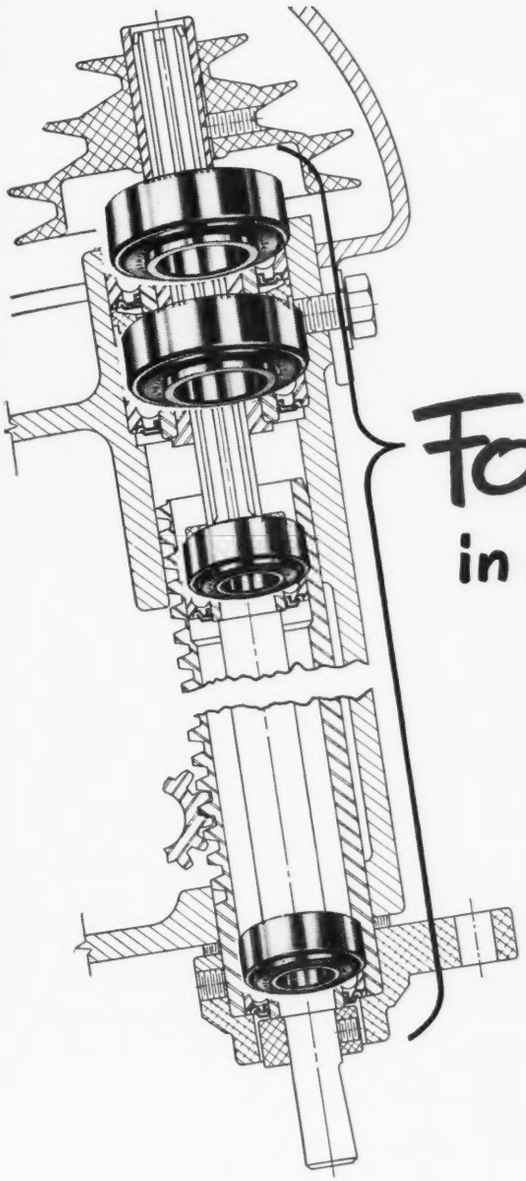
There's a style of Titeflex for almost every need—and Titeflex is *all-metal,* to last longer in any kind of service.

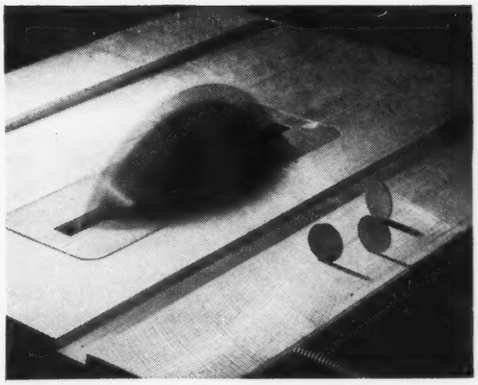
Write for complete catalog.

Titeflex, Inc.

503 FRELINGHUYSEN AVENUE NEWARK 5, NEW JERSEY

TITEFLEX FILLS TUBING REQUIREMENTS TO A... T





FOUR star performers in a "ONE TOOL WORKSHOP"

Here's visual evidence of the Star Performers' worth to the SHOPSMITH . . . an amazingly accurate, versatile, low-priced electric power tool for hobbyists, maintenance departments, and small businesses. With saw blade at full speed, coins stand on edge . . . a tribute not only to the precision construction of the machine, but to the performance of Fafnir Ball Bearings.

Since the SHOPSMITH operates in both vertical and horizontal position and under so many different conditions, the Fafnir head-stock ball bearings are an extremely important factor to successful operation.

Putting accuracy into inexpensive equipment is a problem that Fafnir has solved successfully on many occasions. That's because Fafnir's experience is not limited to just one or two industries but is industry wide. The Fafnir Bearing Company, New Britain, Conn.

FAFNIR

BALL BEARINGS

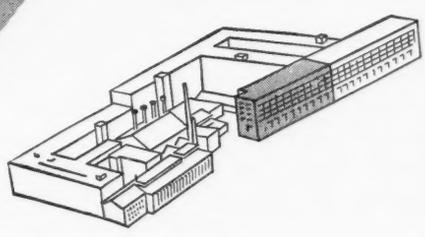
MOST COMPLETE LINE IN AMERICA

BEARINGS SHOWN

The Shopsmith spindle floats on four Fafnir pre-lubricated Mechani-Seal Type Ball Bearings. Two support the spindle in the quill, and two support the internally splined drive shaft.

★ PROGRESS REPORT

DOING OUR BEST



To try to keep abreast of an unprecedented demand for Fafnir Ball Bearings we're doing our best to provide greater production facilities.

One phase of this expansion program is the recently completed, 6-story modern addition to the main Fafnir Plant. It adds 70,000 square feet of manufacturing space to the 750,000 previously included in the 4 Fafnir Plants . . . now, almost 19 acres.

News OF THE INDUSTRY

California and Texas

MODGLIN CO., INC., Los Angeles, Calif., has established a Metal Products Division, which will have facilities for handling metal forming and assembly of sheet and plate aluminum, aluminum alloys, magnesium, and stainless steel. The new facilities will place the company in a position to take sub-contracts for air-frame components. M. G. SIMPSON is manager of the new division.

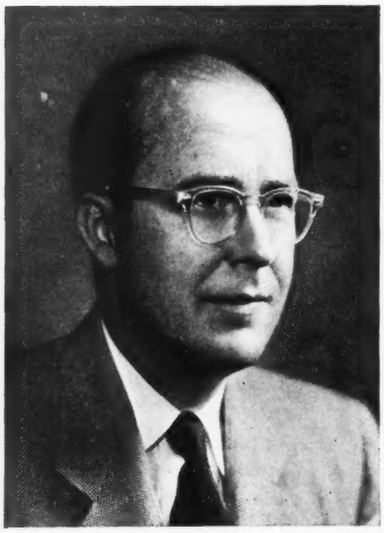
L. E. MENNS, who has been serving as Los Angeles district manager for the Bridgeport Brass Co., Bridgeport, Conn., has been made Pacific Coast sales manager, in charge of the San Francisco district office.

DRESSER INDUSTRIES, INC., Dallas, Tex., announces the formation of a new subsidiary known as DRESSER EQUIPMENT CO. The new company is composed of two former subsidiaries of Dresser Industries—KOBE INC., and the INTERNATIONAL DERRICK AND EQUIPMENT CO.

Illinois

CARL MCWADE, advertising director of Skilsaw, Inc., Chicago, Ill., manufacturer of portable power tools, is the new president of the Chicago Industrial Advertising Association.

Carl McWade, recently elected president of the Chicago Industrial Advertising Association



(Left) Eugene P. Cunningham, new sales manager of the Clearing Machine Corporation. (Right) Ervin J. Baumrucker, assistant sales manager

EUGENE P. CUNNINGHAM has been appointed sales manager of the Clearing Machine Corporation, Chicago, Ill., manufacturer of presses. Mr. Cunningham, formerly connected with the Detroit office, succeeds M. E. PETERSON, who will take over management of operations in Joliet, Ill., where a new plant is to be built. ERVIN J. BAUMRUCKER has been named assistant sales manager. Mr. Cunningham's former position at the Detroit office will be filled by CHARLES KAUDERER.

CRANE PACKING CO., Chicago, Ill., manufacturer of industrial packings and seals, and precision lapping machines, has started the construction of new general offices and plant facilities on Oakton Ave., near Lehigh, in Morton Grove, Ill.

Indiana

DR. C. J. BREITWIESER has been named executive assistant to Dr. F. R. Hensel, vice-president in charge of engineering of P. R. Mallory & Co., Indianapolis, Ind., manufacturer of welding electrodes and dies, powdered-metal products, etc. Dr. Breitwieser was previously chief of electronics and head of the engineering laboratories at Consolidated Vultee Aircraft Corporation, Lindbergh Field, San Diego, Calif.

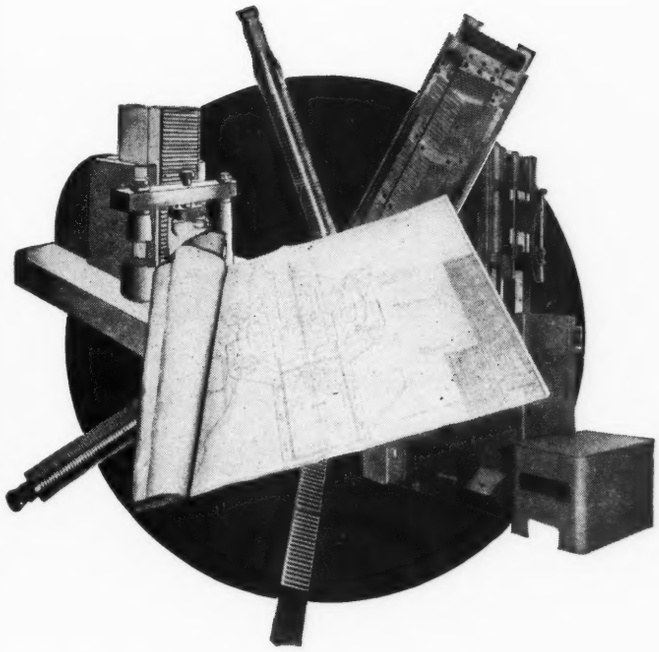
ROBERT E. HUTHSTEINER, executive vice-president of the Cummins Engine Co., Inc., Columbus, Ind., manufacturer of Diesel engines, has been elected president of the company, succeeding J. IRWIN MILLER, who has been made chairman of the board of directors. Mr. Huthsteiner has been associated with the company for almost ten years, and is a member of the present Munitions Board Industry Advisory Committee for Internal Combustion Engines.

WEL-MET CO., Kent, Ohio, manufacturer of self-lubricating bearings and sintered metal powder parts, is planning the construction of an additional plant at Salem, Ind., to meet the increasing demand for the company's products. The new plant is expected to triple production.

LLOYD F. GIEGEL has been made branch manager of the Gary, Ind., sales office of the Reliance Electric & Engineering Co., and DANIEL J. DONNELLY has been added to the sales engineering staff at Philadelphia.

Michigan

JOHN D. GORDON has joined Mechanical Handling Systems, Inc., Detroit, Mich., in the capacity of general sales manager. Mr. Gordon was formerly vice-president and general manager of the Progressive Welder



"Endorsed Broaching"

Are you using this free COLONIAL *service?*

One of the *troubles* with broaching is that the process is so fast and accurate that it is easy to be satisfied with the *initial* results obtained with almost any broaching installation.

Yet, time and again, Colonial Broach engineers have studied new or proposed broaching setups and pointed out where a different type of broach, machine or fixture would greatly improve the operation either as to productivity, product quality, or cost per piece—frequently all three.

Since broaching equipment is inherently expensive as to *first* cost, it is darn good protection to have an installation checked over by Colonial's broaching specialists before broaching equipment or tooling is ordered.

Once you have the equipment, *any* change usually means *increased* investment where previously it might have meant *less.*

And Colonial's "broaching protection" costs you nothing.

For Your Tool Room

A wall or bulletin board poster of DO and DON'T items that should help you reduce broach maintenance cost. No charge. Ask for BN-1250.

PIONEERS OF H.S.S. BROACHING

COLONIAL

BROACH CO. DETROIT 13

Co. of Detroit. He has had a rich background of sales, engineering, and mechanical experience in the special equipment field.

NIAGARA MACHINE & TOOL WORKS, Buffalo, N. Y., manufacturer of presses, shears, and other metal-working machines, has announced the removal of its Detroit branch from the General Motors Bldg. to new and larger offices at 15484 James Couzens Highway. RUSSELL J. CAPLIN is manager of the Detroit branch.

A. W. WINSTON, executive assistant to the manager of the magnesium department of the Dow Chemical Co., Midland, Mich., has been advanced to the post of assistant manager of the department. He has been associated with the company since 1920.

WEST POINT MFG. CO., maker of fixture clamps and fittings, has moved from Farmington, Mich., to a new and larger plant at 26935 W. Seven Mile Road, Detroit 19, Mich.

New England

BAY STATE ABRASIVE PRODUCTS CO., Westboro, Mass., has started work on a $1,200,000 expansion program to meet the increasing demand for the vitrified abrasive products made by the company. The program will include the extension of present factory and storage buildings and the installation of new equipment.

RALPH M. JOHNSON, vice-president in charge of sales of the Norton Co., Worcester, Mass., was recently elected president of the American Supply and Machinery Manufacturers Association. He was previously first vice-president.

Ralph M. Johnson, recently elected president of the American Supply & Machinery Manufacturers Association

(Left) Raymond C. Freeman, manager of General Electric welding divisions
(Right) Alanson U. Welch, manager of engineering of the welding divisions

RAYMOND C. FREEMAN has been named manager of the General Electric Co.'s Welding Divisions at Fitchburg, Mass., and ALANSON U. WELCH will succeed Mr. Freeman as manager of engineering of the divisions.

GENERAL ELECTRIC CO. announces the following changes in personnel in its Turbine Divisions: A. T. CHANDONNET has been made manager of the company's Lynn (Mass.) Turbine Division, and F. S. KOHL has been appointed operation manager of the Fitchburg (Mass.) Turbine Division. CLAYTON S. COGGESHALL has been named assistant to the manager, and ROBERT S. NEBLETT, manager of sales for the General Electric Turbine Divisions.

EDWARD P. BULLARD III has been appointed manager of the new Pratt & Whitney Aircraft branch plant at North Haven, Conn., which will manufacture engine parts for assembly in the main East Hartford plant of the company. Mr. Bullard has been associated with the Bullard Co. of Bridgeport, Conn., for the last eighteen years in the design and manufacture of machine tools, and was assistant general manager, vice-president in charge of manufacturing, and a director of the concern.

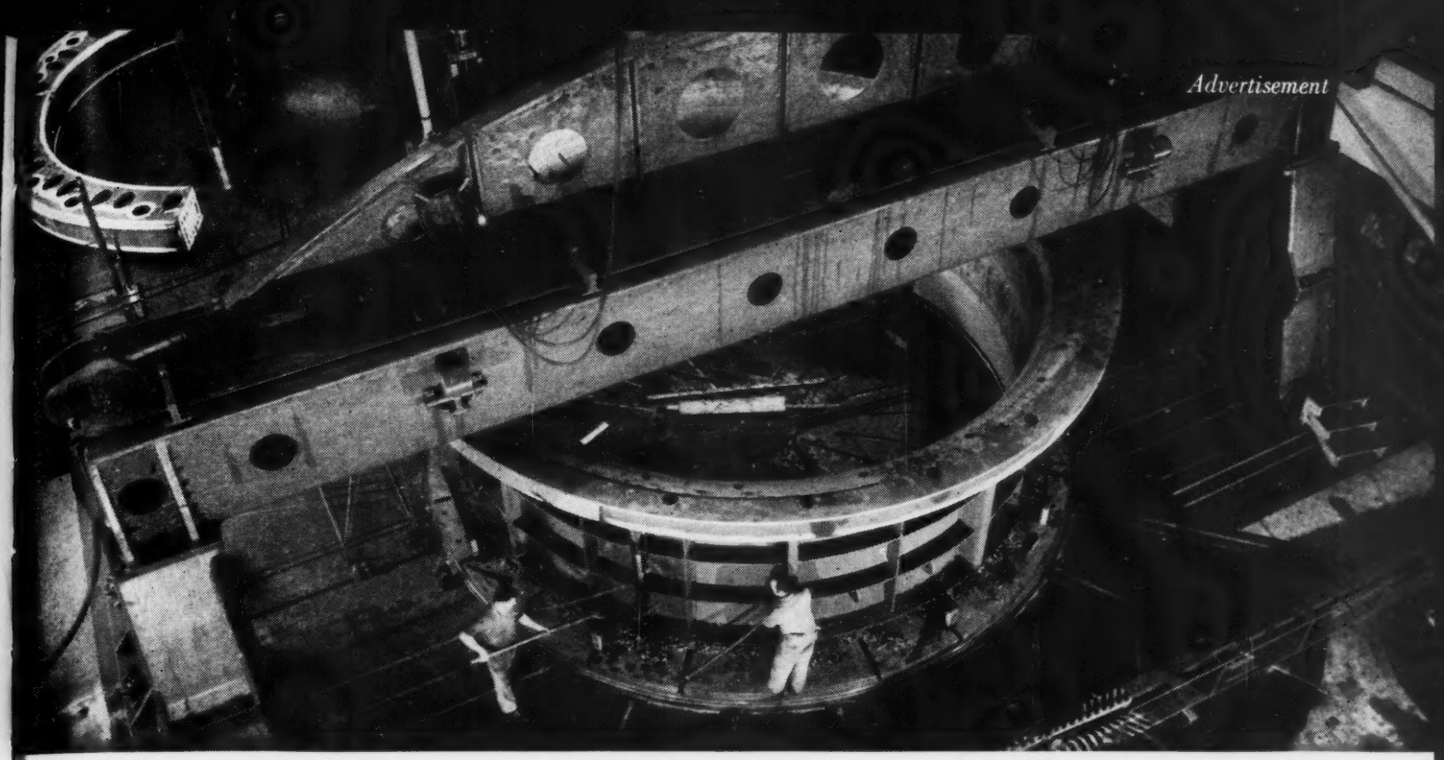
LEON J. DUNN, assistant to the executive vice-president of Veeder-Root, Inc., Hartford, Conn., manufacturer of counting equipment for industrial machinery, has been elected president of the Society for Advancement of Management for the year 1951-1952. Mr. Dunn has been executive vice-president for the past year.

FRANK L. MUNSEY has been appointed assistant plant manager of the Sandusky, Ohio, plant of the New Departure Division, General Motors Corporation, Bristol, Conn. Prior to his new appointment, he was serving as factory manager, and will be succeeded in that post by RAOUL L. LARUE.

GENERAL ELECTRIC CO., Schenectady, N. Y., announces that it has begun manufacturing operations at its new drop-forging die plant in Ludlow, Vt. This new activity is part of the company's expansion program for jet-engine production, the dies being produced primarily for this purpose. H. V. TAYLOR is plant supervisor.

JORDAN D. WOOD has been appointed public relations manager of the Jones & Lamson Machine Co., Springfield, Vt. In this position, Mr. Wood will be responsible for the company's advertising and public relations programs. DESMOND MELLOR will continue in the capacity of advertising manager.

Jordan D. Wood, newly appointed public relations manager of the Jones & Lamson Machine Co.

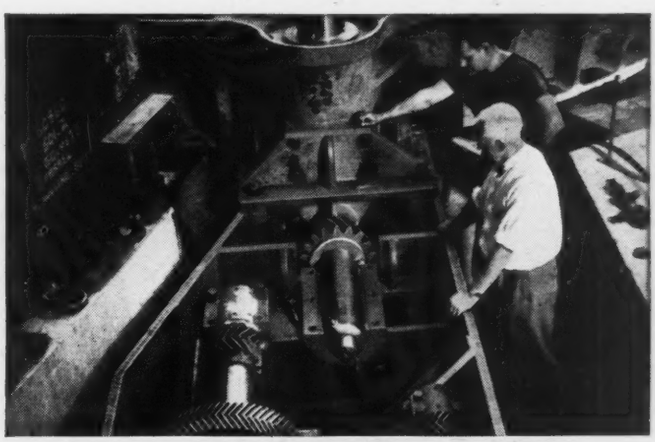


$400,000 VERTICAL BORING MILL, one of the world's largest, bores, turns and faces hydraulic turbine parts. Sunoco Way Lubricant, approved by 39 machine tool builders, was selected by the design engineers to prevent stick-slip with resultant scoring of ways and slides. Even under the weight of work as heavy as 75 tons, Sunoco Way Lubricant has never squeezed out.

TURBINE PARTS 62 FEET IN DIAMETER MACHINED BY HUGE VERTICAL BORING MILL

This mill was installed eight months ago by S. Morgan Smith, well-known hydraulic turbine manufacturer. Without alterations, it can take work up to 22 feet high with a maximum swing of 42 feet between housings. By removing the housings and adding a head to the face plate, it can be modified to handle parts 62 feet in diameter. Sunoco Way Lubricant, specified for the ways and rails by the design engineers, has been used exclusively. The mill accommodates work that weighs as much as 75 tons. No jump or stick-slip has ever marred a finish or impaired accuracy. The ways and rails remain like new. This is typical of the performance that has won the endorsement of 39 machine tool builders for Sunoco Way Lubricant. For an informative booklet and sample, write on your business letterhead to Sun Oil Company, Department M-8, Phila. 3, Pa.

ELECTRONICALLY CONTROLLED CUTTING TOOLS machine a turbine discharge ring 9' high, 27' 8" dia., 21' 8" bore. Sunoco Way Lubricant keeps rails free of rust and corrosion. Starting up after week-end shutdowns, tables and other parts move freely on the ways and slides without jump or stick-slip.



THE SYNCHRONOUS GEAR DRIVE, controlling table speeds from .094 to 6.045 rpm., is pressure-fed with another Sun "Job Proved" product—Sunep. This extreme pressure lubricant is exceptionally stable, minimizes wear, gives long-time protection to very heavily loaded teeth in many types of gear boxes.

New York and New Jersey

EUGENE M. LANG has been elected vice-president in charge of manufacturing of the Heli-Coil Corporation, Long Island City, N. Y., manufacturer of helical-wire thread inserts. Mr. Lang was formerly works manager, and will be succeeded in that position by LOUIS K. RIMER, who also becomes assistant secretary of the corporation.

CHESTER H. LANG, vice-president of the General Electric Co., Schenectady, N. Y., for the last ten years, has been appointed to a new post in charge of public relations. His headquarters will be at the company's executive offices in New York City.

EDWARD H. ROPER has been advanced from the position of assistant manager of the General Technical Sales Department of Air Reduction Sales Co., New York City, to manager of that department.

ARTHUR J. WILLIAMSON has been made vice-president in charge of manufacturing operations for the Tube Reducing Corporation, Wallington, N. J. Prior to this appointment, he was with the Summerill Tubing Co. for thirteen years.

Ohio

R. EDWARD STEIN has been elected vice-president in charge of manufacturing for the Lewis Welding & Engineering Corporation, Cleveland, Ohio. Mr. Stein joined the organization in 1941 as an engineer. He has previously served as plant superintendent and works manager of the Welding and Machine Divisions. Announcement has also been made of the appointment of GLENN JOHNSON as plant manager of the Welding Division.

HERBERT B. LINK, executive vice-president since 1939 of the Bellows Co., Akron, Ohio, manufacturer of pneumatic equipment, has been named president of the company. He succeeds L. F. R. BELLOWS, who died last May. Mr. Bellows' son, L. F. R. Bellows, Jr., has been made vice-president.

JOHN C. COTNER, president of the Hydraulic Press Mfg. Co., Mount Gilead, Ohio, was elected a director of the Machinery Division of the Society of the Plastics Industries Inc., at the annual conference which was held in White Sulphur Springs, Va., recently.

ROBERT T. MCMAHAN, formerly chief engineer of the Boye & Emmes Machine Tool Co., Cincinnati, Ohio, manufacturer of geared-head engine lathes, has been appointed plant manager.

Martin J. Holleran, assistant manager of tool steel sales for the Carpenter Steel Co.

Pennsylvania and Maryland

MARTIN J. HOLLERAN has been named assistant manager of tool steel sales for the Carpenter Steel Co., Reading, Pa. Mr. Holleran joined the company in 1946, and has served as sales engineer in the New York City area until his recent promotion.

GEORGE V. LUERSSEN, formerly chief metallurgist of the Carpenter Steel Co., Reading, Pa., has been appointed vice-president in charge of metallurgy. He succeeds B. H. DELONG, who has retired as vice-president and technical director after forty-one years of continuous service with the company. Mr. DeLong will continue his duties as a member of the board of directors. DR. CARL B. POST will take Mr. Luerssen's place as chief metallurgist, and GEORGE E. BRUMBACH will advance to the position of metallurgist previously held by Dr. Post.

I. MELVILLE STEIN has been elected to the newly created post of executive vice-president of the Leeds & Northrup Co., Philadelphia, Pa., manufacturer of electrical measuring instruments, automatic controls, and heat-treating furnaces. Prior to this appointment, Mr. Stein was vice-president and director of research.

MICHAEL DUFAL, purchasing agent and production manager of Universal Lubricating Systems, Inc., Oakmont, Pa., has been elected vice-president. He joined the company in 1942 as foreman of the automatic screw machine department, and was later promoted to the position of plant superintendent.

UNIFORM TUBES has moved from Shurs Lane and Lauriston St., Roxborough, Philadelphia, Pa., to a new plant at Collegeville, Pa., twenty miles northwest of Philadelphia. It is estimated that the new quarters will provide two and a half times the former production capacity.

WARDEN F. WILSON, general sales manager of the Lebanon Steel Foundry, Lebanon, Pa., was elected president of the Alloy Casting Institute at the annual meeting of the organization which was recently held in Hot Springs, Va.

NORMAN R. AMBERG has been appointed assistant works manager of the Philadelphia Division of the Yale & Towne Mfg. Co., and HARVEY W. WESENBERG has been made supervisor of materials handling. Mr. Amberg was previously chief tool engineer with the Electromotive Division of General Motors Corporation.

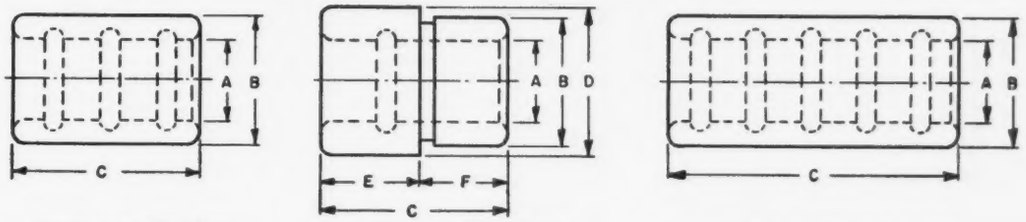
JOHN F. APSEY, JR., advertising manager of the Black & Decker Mfg. Co., Towson, Md., manufacturer of portable electric tools, was elected president of the National Industrial Advertisers Association at the annual conference of the Association held in New York City in June. Mr. Apsey has been advertising manager for Black & Decker since 1935. He has been engaged in NIAA activities for nearly twenty years, and has served as national vice-president of the organization for the last two years. He is also a past-president of Maryland Industrial Marketers, a local chapter of the NIAA. Active in national advertising circles, Mr. Apsey is director of the Advertising Research Foundation, director and past-president of the Exhibitors Advisory Council, member of the Automotive Advertisers Council, and member and past-director of the Association of National Advertisers.

Fabian Bachrach

John F. Apsey, Jr., new president of the National Industrial Advertisers Association

MACHINERY'S DATA SHEETS 687 and 688

AMERICAN STANDARD DIMENSIONS OF GUIDEPOST BUSHINGS FOR PUNCH-PRESS DIE SETS—1



TYPE 1 (REGULAR) TYPE 2 (SHOULDER) TYPE 3 (EXTRA LONG)

Size	Series	Type	Material	Inside Diameter A		Outside Diameter B			Overall Length C	Shoulder		End to Shoulder F	Oil-Grooves	
				Max.	Min.	Nominal	Max.	Min.		Length E	Diameter D		End to Groove	Groove Spacing
1/2	Regular	1	Steel	0.5001	0.4999	.....	0.8142	0.8138	1 1/2	.....	.....	.....	5/16	7/16
		3	Steel	0.5001	0.4999	.....	0.8142	0.8138	3	.....	.....	.....	3/8	9/16
5/8	Regular	1	Steel	0.6251	0.6249	.....	1.0017	1.0013	1 1/2	.....	.....	.....	5/16	7/16
		3	Steel	0.6251	0.6249	.....	1.0017	1.0013	3	.....	.....	.....	3/8	9/16
3/4	Regular	1	Steel	0.7501	0.7499	.....	1.1272	1.1268	1 3/4	.....	.....	.....	5/16	7/16
		2	Steel	0.7501	0.7499	.....	1.1272	1.1268	2 1/4	0.750	1 5/16	1.500	5/16	9/16
		3	Steel	0.7501	0.7499	.....	1.1272	1.1268	3	.....	.....	.....	3/8	9/16
7/8	Regular	1	Steel	0.8751	0.8749	1 3/8	1.3772	1.3768	1 3/4	.....	.....	.....	5/16	9/16
		2	Steel	0.8751	0.8749	1 3/8	1.3772	1.3768	2 1/2	1.266	1 9/16	1.234	5/16	5/8
				0.8751	0.8749	1 3/8	1.3772	1.3768	2 1/2	1.516	1 9/16	0.984	5/16	7/8
		3	Steel	0.8751	0.8749	1 3/8	1.3772	1.3768	3	.....	.....	.....	3/8	9/16

Notes: All dimensions are given in inches. Inside and outside diameters shall be ground or lapped. Oil-grooves may be omitted if provided in guideposts.

MACHINERY'S Data Sheet No. 687, August, 1951

Approved by American Standards Association as B5.25-1950

AMERICAN STANDARD DIMENSIONS OF GUIDEPOST BUSHINGS FOR PUNCH-PRESS DIE SETS—2

Size	Series	Type	Material	Inside Diameter A		Outside Diameter B			Overall Length C	Shoulder		End to Shoulder F	Oil-Grooves	
				Max.	Min.	Nominal	Max.	Min.		Length E	Diameter D		End to Groove	Groove Spacing
1	Regular	1	Steel	1.0001	0.9999	1 1/2	1.5022	1.5018	1 3/4	.....	.....	.....	5/16	9/16
		2	Steel	1.0001	0.9999	1 1/2	1.5022	1.5018	2 1/2	1.266	1 11/16	1.234	5/16	5/8
		3	Steel	1.0001	0.9999	1 1/2	1.5022	1.5018	3	.....	.....	.....	3/8	9/16
1 1/8	Regular	1	Steel	1.1251	1.1249	1 5/8	1.6272	1.6268	2	.....	.....	.....	3/8	5/8
		2	Steel	1.1251	1.1249	1 5/8	1.6272	1.6268	2 3/4	1.391	1 13/16	1.359	3/8	11/16
				1.1251	1.1249	1 5/8	1.6272	1.6268	2 1/2	1.266	1 13/16	1.234	5/16	5/8
		3	Steel	1.1251	1.1249	1 5/8	1.6272	1.6268	3	.....	.....	.....	3/8	9/16
1 1/4	Regular	1	Steel	1.2501	1.2499	1 3/4	1.7522	1.7518	2	.....	.....	.....	3/8	5/8
		2	Steel	1.2501	1.2499	1 3/4	1.7522	1.7518	3	1.516	1 15/16	1.484	3/8	3/4
				1.2501	1.2499	1 3/4	1.7522	1.7518	2 3/4	1.391	1 15/16	1.359	3/8	11/16
		3	Steel	1.2501	1.2499	1 3/4	1.7522	1.7518	3	.....	.....	.....	3/8	9/16
1 1/2	Regular	1	Steel	1.5001	1.4999	2	2.0027	2.0023	2	.....	.....	.....	3/8	5/8
		2	Steel	1.5001	1.4999	2	2.0027	2.0023	3	1.516	2 3/16	1.484	3/8	3/4
		3	Steel	1.5001	1.4999	2	2.0027	2.0023	3	.....	.....	.....	3/8	9/16
1 3/4	Regular	3	Steel	1.7501	1.7499	2 1/4	2.2529	2.2525	3	.....	.....	.....	3/8	9/16
		2	Steel	1.7501	1.7499	2 1/4	2.2529	2.2525	3 15/32	1 1/2	2 1/2	1 31/32	1	2
2	Regular	3	Steel	2.0023	2.0020	2 1/2	2.5032	2.5028	3	.....	.....	.....	3/8	9/16
		2	Steel	2.0023	2.0020	2 1/2	2.5032	2.5028	3 15/32	1 1/2	3 1/8	1 31/32	1	2
2 1/2	Regular	3	Steel	2.5028	2.5025	3	3.0035	3.0031	3	.....	.....	.....	3/8	9/16
		2	Steel	2.5030	2.5025	3	3.0035	3.0031	3 31/32	2	3 5/8	1 31/32	1	2
3	Regular	2	Steel	3.0030	3.0025	3 5/8	3.6290	3.6285	3 31/32	2	4 1/8	1 31/32	1	2

Notes: All dimensions are given in inches. Inside and outside diameters shall be ground or lapped. Oil-grooves may be omitted if provided in guideposts.

MACHINERY'S Data Sheet No. 688, August, 1951

Approved by American Standards Association as B5.25-1950

EX-CELL-O

Blade Machining Equipment

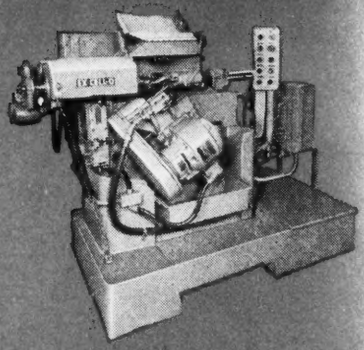
NOW AVAILABLE

Compressor blade for turbojet aircraft engine.

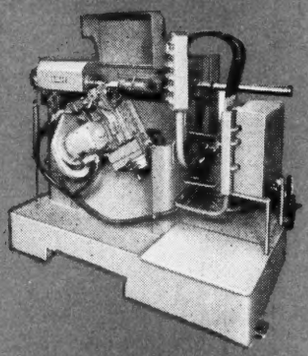
XLO

EX-CELL-O Air PRECISION

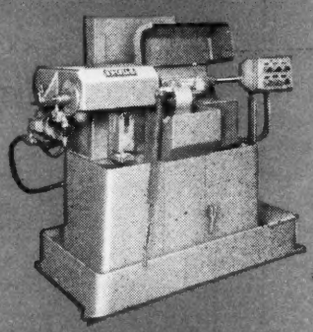
Three Production-Proved Machines Mill, Grind and Polish Airfoil Forms



Ex-Cell-O Precision Profile Miller, Style 86, mills the complete airfoil form including leading and trailing edges. Work is supported rigidly by back rests throughout the cutting stroke.



Ex-Cell-O Precision Profile Grinder, Style 87, grinds the complete airfoil form including leading and trailing edges. Work speeds change automatically during rotation as area of contact between wheel and work varies.



Ex-Cell-O Precision Profile Polisher, Style 88, polishes the airfoil form with an abrasive belt which passes over a rubber pulley at point of work contact.

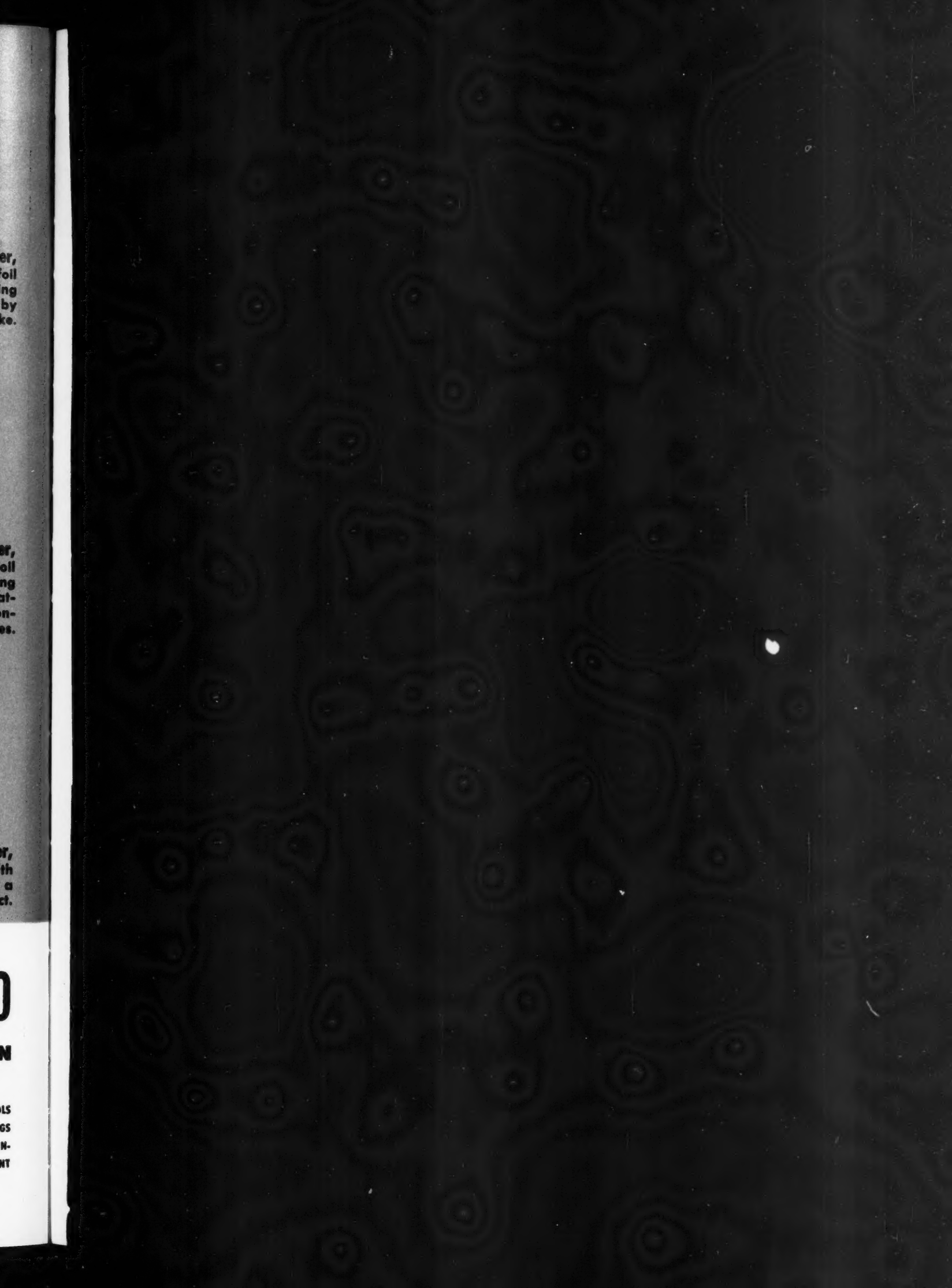
The complex job of finishing the airfoil form of compressor blades for jet aircraft engines is now done speedily, accurately, and automatically by three Ex-Cell-O standard machines. Production-proved, these machines mill, grind, and polish, respectively, with completely automatic machining cycles. Operator merely loads, unloads, and pushes start button. For further information and specifications contact Ex-Cell-O in Detroit today.

EX-CELL-O

CORPORATION

DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS CUTTING TOOLS • RAILROAD PINS AND BUSHINGS DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT



Coming Events

SEPTEMBER 1-10—EUROPEAN MACHINE TOOL EXHIBITION at the Porte de Versailles, Paris, France.

SEPTEMBER 10-15—Third annual NATIONAL INDUSTRIAL ENGINEERING CONFERENCE at Michigan State College, East Lansing, Mich.

OCTOBER 4-5—Thirty-third annual meeting of the American Ordnance Association at the Netherland-Plaza Hotel, Cincinnati, Ohio (October 4) and at the Wright-Patterson Air Force Base, Dayton, Ohio (October 5). Further information can be obtained from the American Ordnance Association, Mills Bldg., Washington 6, D. C.

OCTOBER 8-12—THIRTY-NINTH NATIONAL SAFETY CONGRESS AND EXPOSITION in Chicago, Ill. For further information, write R. L. Forney, general secretary, National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

OCTOBER 15-19—Thirty-third annual METAL SHOW and NATIONAL METAL CONGRESS at Detroit, Mich. Sponsored by the American Society for Metals; American Welding Society; Metals Branch, American Institute of Mining and Metallurgical Engineers; and Society for Non-Destructive Testing. Further information can be obtained from W. H. Eisenman, managing director, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

OCTOBER 15-19—FIRST WORLD METALLURGICAL CONGRESS in Detroit, Mich. Sponsored by the American Society for Metals, and to be held concurrently with the annual National Metal Congress and Exposition. For further information, address William H. Eisenman, managing director, American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio.

OCTOBER 22-24—Seventh annual ELECTRONICS CONFERENCE at the Edgewater Beach Hotel in Chicago, Ill. Publicity committee chairman, J. W. Armsey, Illinois Institute of Technology, Chicago 16, Ill.

NOVEMBER 1-2—Fifteenth annual TIME AND MOTION STUDY AND MANAGEMENT CLINIC at the Sheraton Hotel in Chicago, Ill. Sponsored by the Industrial Management Society. Further information can be obtained by addressing the Society at 35 E. Wacker Drive, Chicago 1, Ill.

NOVEMBER 19-20—Fifty-second annual convention of the NATIONAL METAL TRADES ASSOCIATION (originally scheduled for September 26-28) at the Palmer House in Chicago, Ill. Further information can be obtained from Homer D. Sayre, Commissioner, 122 S. Michigan Ave., Chicago 3, Ill.

JANUARY 14-17, 1952—PLANT MAINTENANCE SHOW and PLANT MAINTENANCE CONFERENCE at Convention Hall in Philadelphia, Pa. Further information can be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York City.

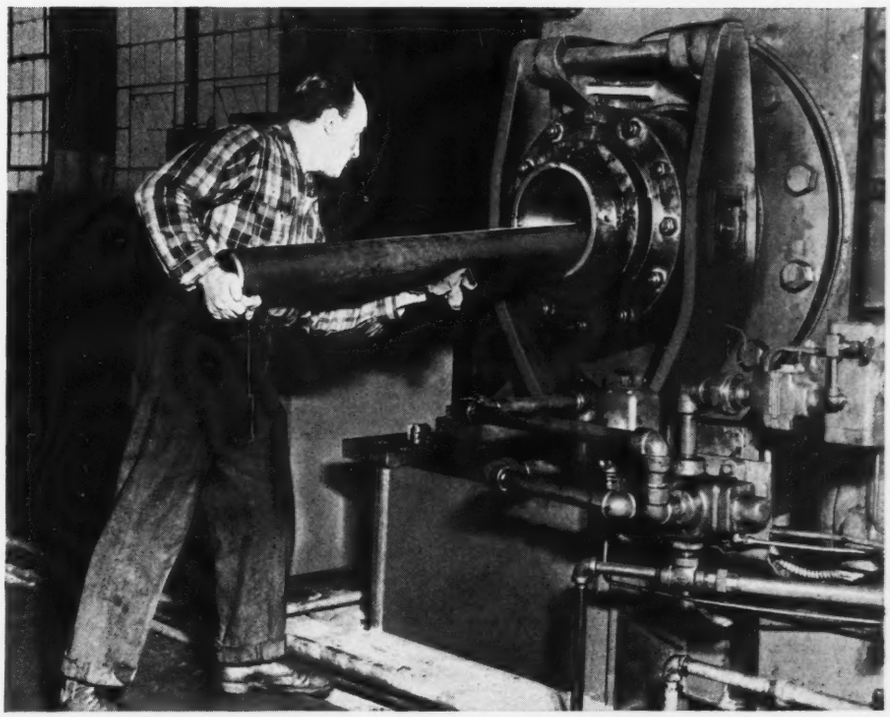
Obituary

GEORGE F. SMITH, sales representative in the southeast and southwest districts, of Heller Brothers Co., Newcomerstown, Ohio, died on May 23 at his home in Baltimore, Md. Mr. Smith had been associated with the company for over forty years. He was well known in hardware circles, and his name had been placed on the "Roll of Honor" of the Southern Hardware Jobbers Association.

Mr. Smith is survived by three sons, one of whom—Paul E. Smith—is at present southeastern sales representative of Heller Brothers Co.

* * *

Three-fourths of all freight tonnage moved in the United States today goes by motor truck, according to the Automobile Manufacturers Association. An AMA study of government transportation statistics reveals that trucks now carry 8,300,000,000 tons of freight yearly. During World War II, trucks hauled up to 75 per cent of both inbound and outbound freight at war plants.



A length of steel tubing is shown being inserted into a new Westin Process machine, where it will be necked down by dies which bring the tube to white heat in seconds by passing electric current through the cylinder metal. The Tube Reducing Corporation adopted the Westin Process machines in order to obtain the advantages that result from being able to size and form the ends of close-tolerance tubing in one operation.

New Books and Publications

THE BEHAVIOR OF ENGINEERING METALS. By H. W. Gillett. 395 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $6.50.

The problem of selecting the right metal or alloy to fit a given use is no longer a simple matter. It has become increasingly complex as the number of metallic materials and of methods of preparing them has increased, and as service conditions have become more severe. Non-metallurgists whose job it is to select metals and alloys for engineering use, should, therefore, find this book of considerable aid. The behavior of the materials is discussed rather than the theories that explain this behavior.

The first six chapters introduce the basic concepts of metallurgy and describe the terminology, giving examples showing how the different terms are used; the next nine chapters deal with the behavior of each of the principal commercial metals and alloys, covering tonnage steels; wrought steels; heat-treated steels; cold-worked metals; ferrous castings; non-ferrous cast alloys; wrought alloys; and heavy metals. The remainder of the book is devoted to special considerations that influence the selection of metals and alloys, including such matters as machinability; special fabricating techniques; and means of using or selecting metals so as to combat the effects of corrosion, wear, and high temperature. The final chapter treats of cost and availability.

PRINCIPLES AND METHODS OF SHEET-METAL FABRICATING. By George Sachs. 526 pages, 6 by 9 inches. Published by the Reinhold Publishing Corporation, 330 W. 42nd St., New York 18, N. Y. Price, $10.

Written by a technical expert on the cold-working of sheet metals and a consultant of the National Advisory Committee for Aeronautics, this book is an outstanding reference work in its field. It describes in great detail the principles of numerous sheet-metal forming methods. The book covers the theory of deformation of sheet metal and tubing; the metallurgical effects of stamping, drawing, extruding, bending, etc., and the practical operations involved; the design of parts and dies; and the production equipment used for these operations.

The text is arranged in five parts dealing with the following subjects: Sheet-metal and sheet-metal parts; principles of forming various type parts, including contour forming and the forming of recessed parts; principles of deep-drawing; press-die forming of sheet-metal parts, including cartridge-case fabricating; and various sheet-metal forming methods, such as drop-hammer forming, rubber forming, stretch forming, etc.

Numerous examples of commercial work are given and analyzed, so that the reader can easily understand just how specific jobs are done.

MECHANICAL MEASUREMENTS BY ELECTRICAL METHODS. By Howard C. Roberts. 357 pages, 4 1/2 by 8 inches. Published by the Instruments Publishing Co., Inc., 921 Ridge Ave., Pittsburgh 12, Pa. Price, $4.

The increasing use of electric gaging methods and the application of electric gaging principles in many fields of measurement and in automatic control has created a demand for specific information on this subject. To meet this need, a book on mechanical measurements by electrical methods was published about four years ago, and is now in its second edition. There are no major revisions in the present edition. Some of the devices shown in the first edition have been superseded by later models, but the basic principles are unchanged.

The text is divided into two parts. The first part, dealing with principles of operation, describes various types of gaging methods, including photo-electric, thermo-electric, acoustic, and many other types of gages. The second part describes the equipment used, covering calibrating devices and calibration-checking circuits; oscillographs; power supplies; amplifiers and computing devices; and self-contained gaging systems.

METAL PROCESSING. By Orlan William Boston. 763 pages, 6 by 9 inches. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price, $7.50.

This book on machine shop practice gives all the information needed for the manufacture of metal parts, including the design of the part, the selection of machine tools, cutting tool materials, tool shapes, power, speeds, and feeds. The steps required in designing for production are covered in the first chapter, and subsequent chapters treat of the various classes of machine tools, and the operations performed on them. Measuring and gaging are also given attention, and accounting and costs are discussed in the final chapter.

The second edition, just published, incorporates new technical data developed during and since World War II. The text has been completely revised, a chapter has been added on surface quality, and the chapters on machinability and machine tool drives have been enlarged.

While this book was written as a text-book for college use, it is suitable for industrial courses and should also be of value as a reference for production, tool, and design engineers, as well as superintendents.

CARBIDE CUTTING TOOLS. By Warren Baker and Joseph S. Kozacka. 416 pages; 283 illustrations. Published by the American Technical Society, Chicago, Ill. Distributed by the Educational Training Department, Vascoloy-Ramet Corporation, Waukegan, Ill. Price, $5.50.

Here, for the first time, complete information has been made available on carbide tools and cutting problems, gathered from every possible source. The book, which is so written that it will be readily understood by the novice, as well as the technician, covers the development of tools since the beginning of their history up to the adoption of carbide materials. Every phase of carbide use is included in the seventeen chapters dealing with converting; tool angles; tipping; grinding; power speeds; design; coolants; milling cutters; selection; assembly; and general applications.

The Vascoloy-Ramet Corporation furnishes with this book a study guide prepared by the American Technical Society, which can be used either at home or in employe training programs in the shop.

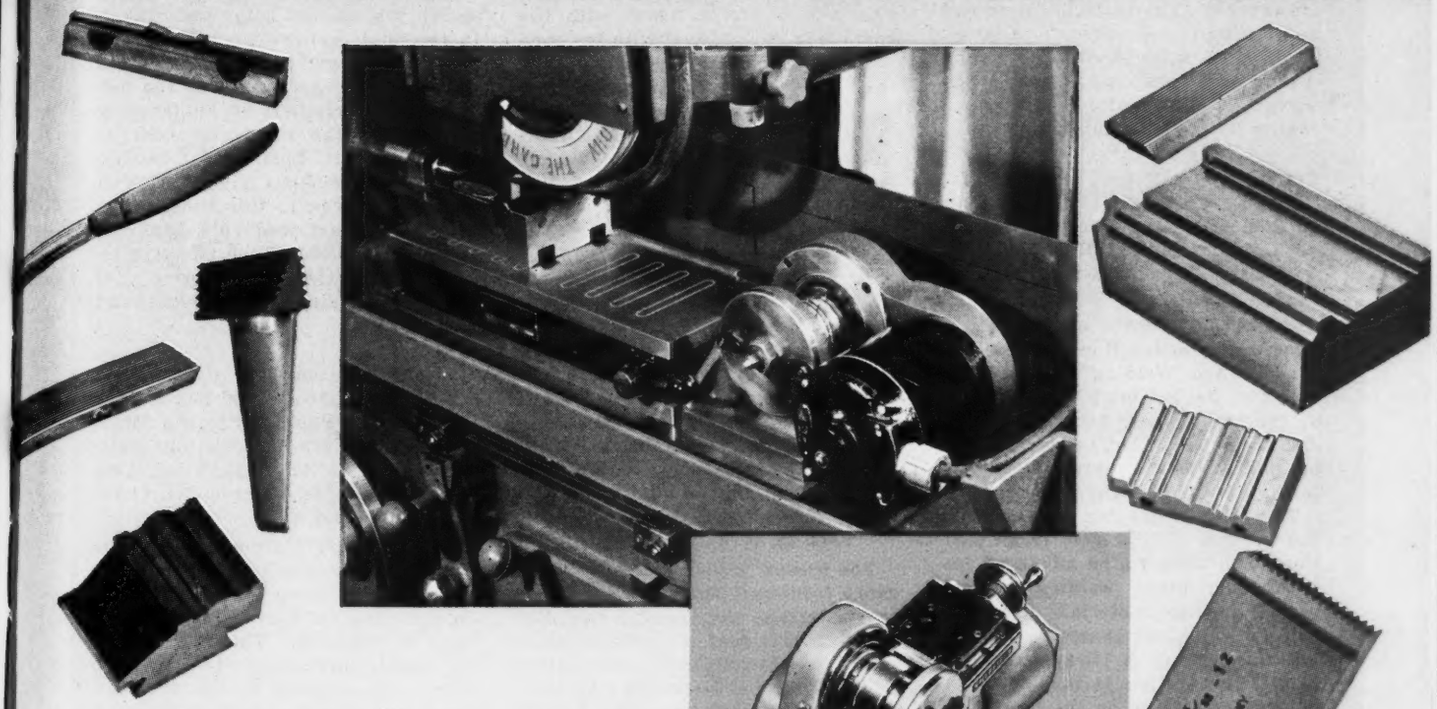
SYMPOSIUM ON ULTRASONIC TESTING. 133 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price (paper-bound), $2.

Ten papers and discussions presented in a symposium on ultrasonic testing at a meeting of the American Society for Testing Materials are republished in this Special Technical Publication No. 101. The book covers a summary of the history, theoretical aspects, and basic principles of practical testing, as well as applications of ultrasonic testing of materials, a method being extensively used today.

INSPECTION ORGANIZATION AND METHODS. By James E. Thompson. 369 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $5.

Tested methods of improving efficiency, simplifying procedures, and reducing costs in inspection departments are presented in this book. The procedures outlined may be applied regardless of the product being made or the quality level being maintained. Required data for the orderly plan-

Equip for Crushtrue Grinding to Speed Production and Cut Costs



You can produce the kind of work shown here faster and more economically with Sheffield Crushtrue Dressing Devices, and Crushtrue Dressing Rolls.

Dressing the grinding wheel by Crushtrue equipment (1) is very much faster than diamond dressing, (2) increases the cutting capacity of the wheel, (3) greatly reduces generated heat in grinding, (4) minimizes the tendency of the wheel to "load up" (5) reduces the actual grinding time as much as 75%.

Idler, Motorized and Self-truing Crushtrue Devices are available. Your selection will depend upon the work you do and the grinding equipment you have.

Crushtrue rolls for standard threads can be shipped immediately from a Sheffield "bank." Rolls for special forms for users engaged in long run production schedules can also be included in this stock on hand. Users send in rolls to be reground and immediately replacements from Sheffield's bank are forwarded at nominal cost. This relieves the user from the expense of ever having to buy new rolls.

Write for information on the Sheffield "Crushtrue Roll Bank" and specifications on these Crushtrue Devices.

5678

the *Sheffield* corporation

Dayton 1, Ohio, U. S. A.

GAGES • MEASURING INSTRUMENTS • MACHINE TOOLS
CONTRACT SERVICES • THREADING TOOLS

ning, accomplishment, and recording of inspection examination and testing are supplied. Also, an explanation of inspection job requirements and comparative evaluations is given.

Such recent developments as the automatic Sonigage and the Magniglo and Statiflux processes of non-destructive testing for defects in non-magnetic and non-metallic materials are covered. The material presented is intended to help executives on all levels to set up an effective inspection organization and determine procedures to be followed in maintaining quality level with minimum expense.

NEW LESSONS IN ARC WELDING. 312 pages, 5 1/2 by 8 1/2 inches. Published by the Lincoln Electric Co., Cleveland 1, Ohio. Price, $1 in the United States; $1.50 elsewhere.

This book is based on a series of lessons and instruction given at the Lincoln Arc Welding School. The object of the lessons is to present in a concise manner certain fundamental facts, so that the welder will be able to use this process successfully and economically.

The basic thirty-two lessons cover the welding of mild steel in all positions, and twenty-nine advanced lessons cover other welding applications. Practice materials, exercises, and questions and answers are given for each lesson. A 163-page welding application section is included. Information is given on the latest procedures for faster and lowest-cost welding; automatic and semi-automatic hidden-arc welding methods; how to select correct welding joints; and how to make common machine parts so as to use welding instead of casting.

MECHANICS OF MATERIALS. By Harry D. Conway. 325 pages, 6 by 9 inches. Published by Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N. Y. Price, $6.35.

Written as a course in the mechanics of materals, this book is the result of the author's experience in teaching the subject for several years. Many examples are given to show the application of theories to practical problems. An idea of the treatment will be obtained by the following list of chapter headings: Elementary Stress and Strain; Compound Stress and Strain; Welded and Riveted Joints; Theory of Torsion; Shearing and Bending of Beams; The Stresses in Beams; Deflection Due to Bending; Clamped and Continuous Beams; Miscellaneous Beams; Columns; Failure under Combined Stresses; Thick Cylindrical and Spherical Shells Subjected to Uniform Pressure; Statical Indeterminacy and Castigliano's Theorem. An appendix dealing with moments of inertia of areas is included.

MACHINERY'S GEAR DESIGN HANDBOOK. By W. A. Tuplin. 72 pages, 7 1/4 by 9 1/2 inches. Published by the Machinery Publishing Co., Ltd., Brighton, England. Sold in the United States by THE INDUSTRIAL PRESS, 148 Lafayette St., New York 13, N. Y. Price $2.50.

This is the second revised edition of a book prepared to provide the man who wants to learn, with the least study, how to deal with the common problems of gear design. Simple rules for gear design, based on long experience, are presented, and examples are worked out to make clear their application in solving typical problems. In the new edition, improved methods of design for worm-gears and spiral gears are described. The types of gears discussed in the book are spur gears, helical gears, bevel gears, worm-gears, and spiral gears. Attention should be called to the fact that the material is based on British practice and standards.

ENGINEERING MATERIALS MANUAL. Edited by T. C. DuMond. 386 pages, 8 1/2 by 11 3/4 inches. Published by the Reinhold Publishing Corporation, 330 W. 42nd St., New York 18, N. Y. Price, $4.50.

The present national defense emergency focusses attention on engineering materials, and makes a complete guide in this field of great value to industry. Descriptive information and reference data covering all engineering materials are given in this manual. The book represents a collection of articles previously published in *Materials and Methods*. It comprises twenty-eight sections, each one presenting the complete story of a single material or group of materials. There are sections on irons, steels, stainless steels, aluminum, magnesium, copper alloys, plastics, rubber, ceramics, several types of finishes and coatings, and many other materials. Important engineering information is included.

MODERN INTERFEROMETERS. By C. Candler. 502 pages, 6 by 9 inches. Published by Hilger & Watts, Ltd., 98 St. Pancras Way, Camden Road, London N.W. 1, England. Obtainable from the Jarrell Ash Co., 165 Newbury St., Boston, Mass. Price, $9.75.

This is said to be the first book to deal exclusively and comprehensively with interferometers and to provide the simple theory essential for those who use these instruments in engineering, astronomy, chemistry, nuclear physics, and surveying. In engineering, interferometers have long been used to standardize end gages, and they are being used increasingly in the manufacture of slip gages, as well as in tool-rooms of large factories. The various types described are grouped according to their use.

REVIEW OF CURRENT RESEARCH AND DIRECTORY OF MEMBER INSTITUTIONS (1951). 244 pages, 6 by 9 inches. Published by the Engineering College Research Council of the American Society for Engineering Education, 77 Massachusetts Ave., Cambridge 39, Mass. Price, $2.25.

More than 5200 engineering research projects are being undertaken in the engineering schools of American colleges and universities at the present time. An outline of the policies and activities of engineering research in the ninety-one colleges and universities holding membership in the Engineering College Research Council is given in this book. In a time of national need, this catalogue is a useful guide to the effective research activities and capacity of American engineering colleges and universities.

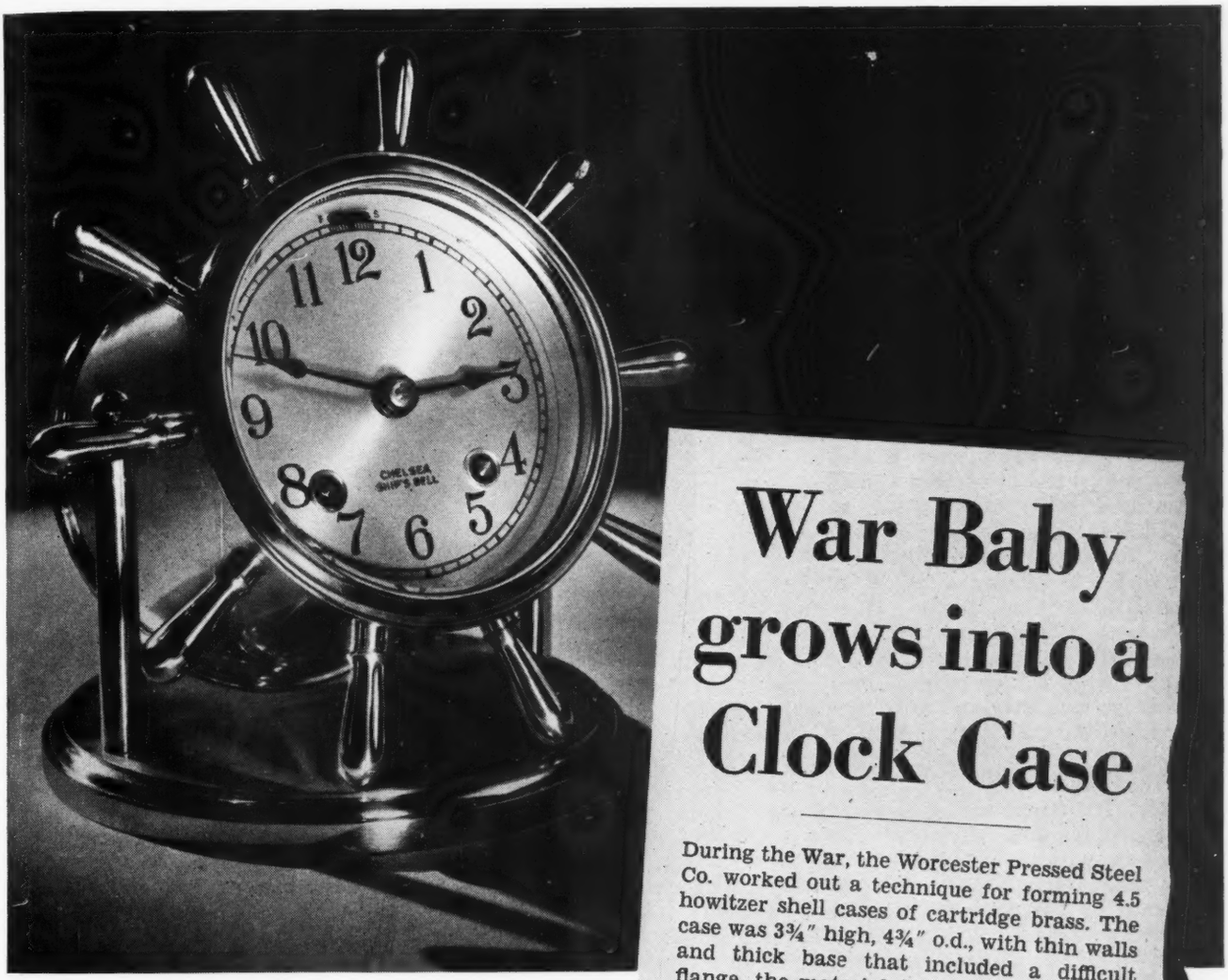
ASTM STANDARDS ON COPPER AND COPPER ALLOYS. 530 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price, paper-bound, $4.35; cloth-bound, $5.

The 108 ASTM standards pertaining to copper and copper-base alloy products have been brought together in this book in convenient form for use in industry. These standards represent the most up-to-date practices. In addition to the specifications for cast and wrought copper and copper alloys, copper and copper-alloy electrical conductors, and nonferrous metals used in copper alloys, ten methods are included covering expansion, mercurous nitrate, resistivity, and tension tests, preparation of micrographs, hardness, sampling, and grain-size evaluations for wrought copper and copper alloys.

BALL AND ROLLER BEARING ENGINEERING. 270 pages. Published by S K F Industries, Inc., Philadelphia 32, Pa. Price in the Continental United States, $1.75.

First published in 1945, this anti-friction bearing manual is now being made available to engineers, product designers, maintenance men, and engineering students in the interest of the present defense economy. It covers such subjects as bearing types and nomenclature, capacities, selection, design, installation, maintenance, causes of failures, and load calculations.

ENGINEERING STANDARDS FOR MULTIPLE V-BELT DRIVES. 16 pages, 8 1/2 by 11 inches. Distributed by the Multiple V-Belt Drive Association, 7 W. Madison St., Chicago 2, Ill., and the Rubber Manufacturers Association, Inc., 444 Madison Ave., New York 22, N. Y. Price, 50 cents.



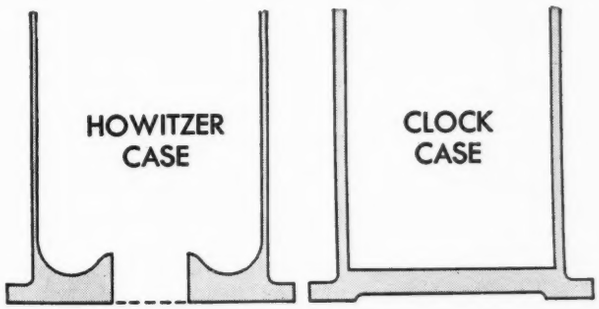
Chelsea Ship's Bell Clock, The Vanderbilt model, made by Chelsea Clock Co., Chelsea 50, Mass. Case drawn in one piece out of commercial brass by Worcester Pressed Steel Co., Worcester 6, Mass.

War Baby grows into a Clock Case

During the War, the Worcester Pressed Steel Co. worked out a technique for forming 4.5 howitzer shell cases of cartridge brass. The case was 3¾" high, 4¾" o.d., with thin walls and thick base that included a difficult flange, the material for which had to flow entirely from the base of the cup. The successful solution of the many problems required careful tool design, plus skilled control of each operation.

Later the Chelsea Clock Co. asked Worcester if it could cold-form clock cases out of commercial brass. A study of the clock case revealed striking similarities between it and the howitzer case, but on the other hand there was one important difference. The large radius on the inside of the howitzer case was not permissible in the clock case, because of the space required for the works. It was found that the bottom design could be achieved by squaring the case to the exact height, providing the bottom knockout with exactly the correct amount of spring tension in the restrike, and carefully governing the pressure and speed of press travel. The complete coordination of these factors resulted in a perfect case, and another example of the adaptation of war-learned skills to peace-time products.

• If you have problems in connection with the fabrication of copper and its alloys, or aluminum alloys, remember that the Revere Technical Advisory Service often can be helpful.



Cross sections showing similarities and differences between the howitzer case and the clock case.

REVERE 150th YEAR OF SERVICE TO AMERICA

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere

SEE "MEET THE PRESS" ON NBC TELEVISION EVERY SUNDAY

Measuring Lathe Cutting Tool Loads with Strain Gages

THE measurement of the components of tool loads on a lathe was among the problems solved by engineers of the Jones & Lamson Machine Co., Springfield, Vt., in preparing for a broad research program on carbide high-velocity turning. The solution of this problem was based on the use of SR-4 resistance wire strain gages which were bonded to a special tool-holder and a small cantilever beam in such a way as to enable radial, tangential, and feed forces to be determined.

These strain gages, made by the Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa., are essentially tiny grids of fine wire which, when bonded to a strained member, are strained with the member, thus changing their electrical resistance.

The development of a tool-holder for measuring these components required designing for rigidity, with no loss of sensitivity or accuracy. This was accomplished by the use of a massive toolpost *A*, Fig. 1, having a round hole in which the tool-holder *B* was clamped. A slot in the top of the toolpost provided for clamping the tool-holder by means of three cap-screws.

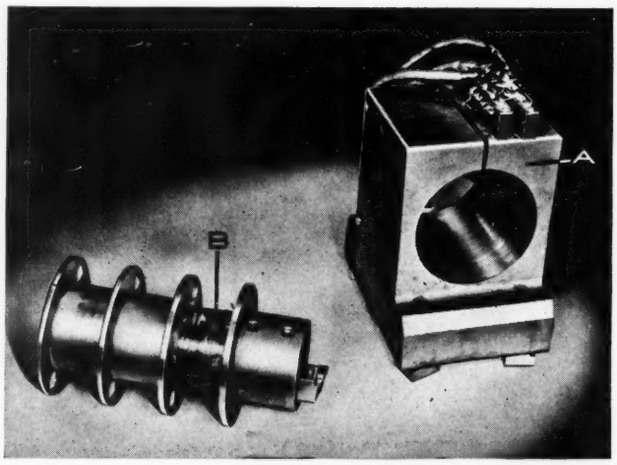


Fig. 1. A special toolpost (A) and tool-holder (B) employed with SR-4 strain gages to measure lathe cutting tool loads

The tool-holder was machined from a solid piece of steel, the flanged length being bored and turned to a tubular section. A square hole was made in the solid end to receive 1- by 1-inch tools. It was located so that the cutting edge of the tool could be kept on the axis of the holder. This minimized errors from torque interference with components of tool loads. An end plate was pressed into the rear end of the holder and fitted with a steel ball.

Two sets of strain gages were cemented to the holder behind the flange nearest the cutting edge. This flange, outside of the toolpost, served as a guard for four of the gages. The tangential load on the tool was measured by two gages on the top and bottom of the holder, and the feed load by two gages placed on the sides of the holder. The radial, or shank, load was indicated by a set of gages on a cantilever supported at the rear end of the toolpost, Fig. 2, at right angles with the axis of the tool-holder.

The upper end of the cantilever was in contact with the ball at the rear of the holder, and was slightly preloaded in order to assure good contact. The location of the ball was such that bending loads on the tool-holder would have minimum effect on radial tool loads. The three sets of strain gages on the tool-holder were connected to universal analyzers and direct-inking oscillographs, which made simultaneous records.

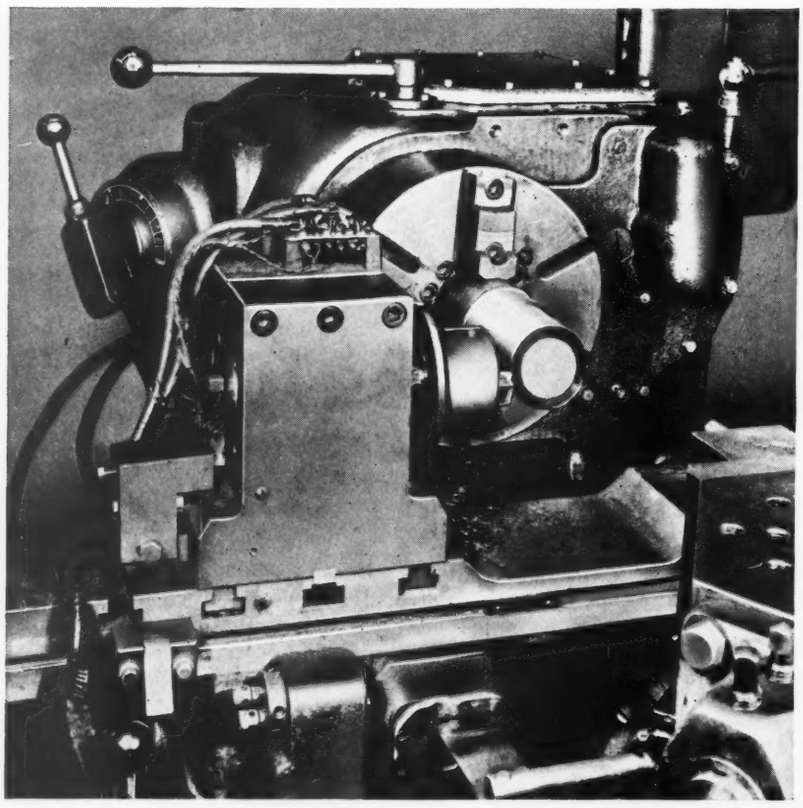


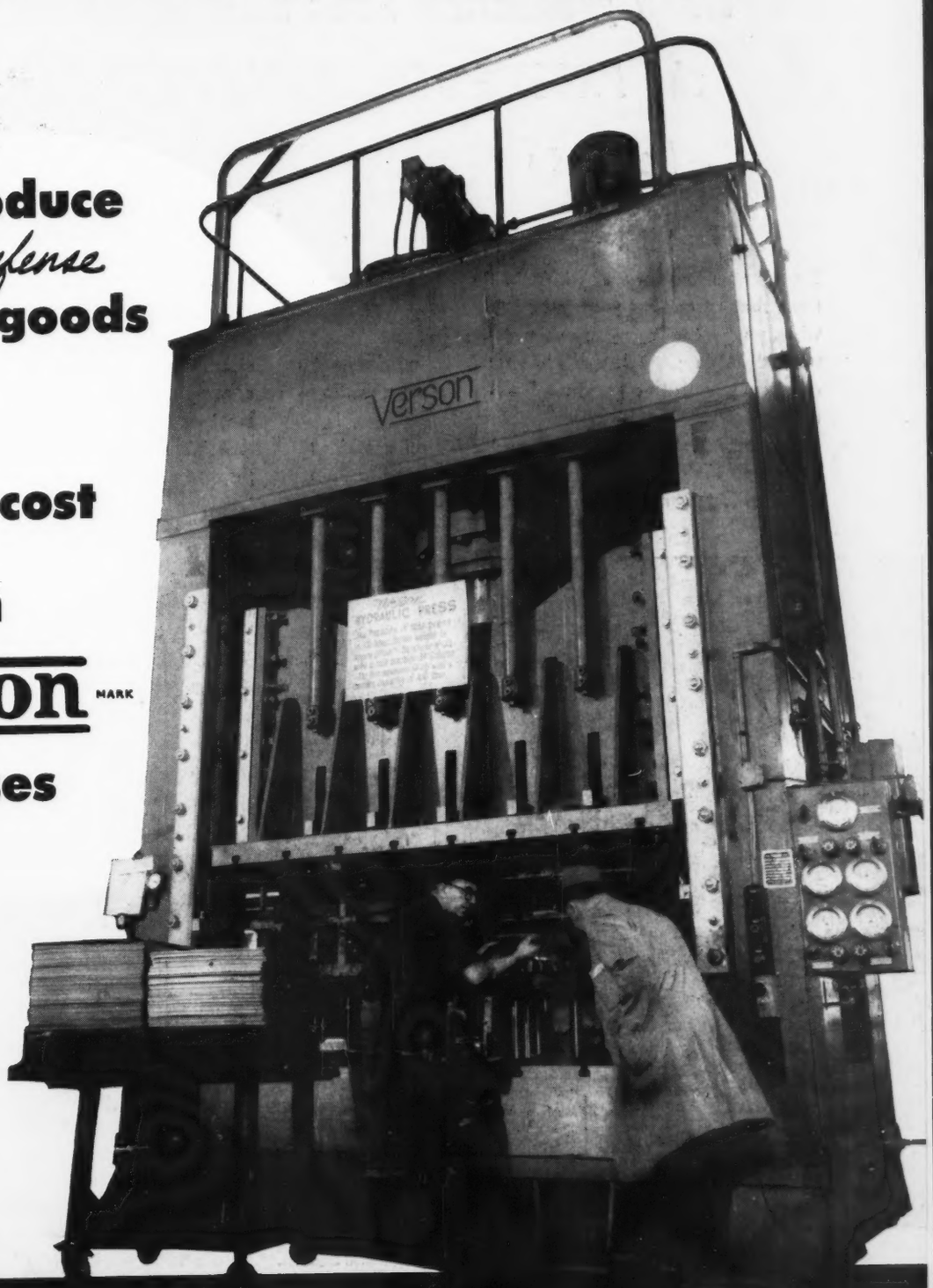
Fig. 2. Toolpost and tool-holder set up in turret lathe for measuring cutting tool loads

AUGUST 1951—FIFTY-SEVENTH YEAR

MACHINERY

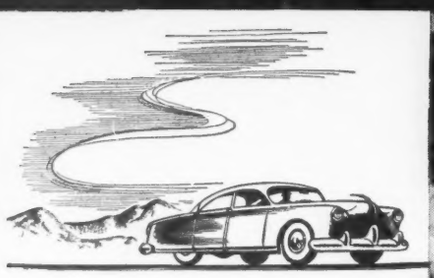
UNIV. OF MICHIGAN
AUG 10 1951
LAST ENGINEERING LIBRARY

Produce *Defense* goods
MORE
at
LOWER cost
with
TRADE Verson MARK
presses



800 ton Verson hydraulic press used by Stolper Steel Products Corp., Milwaukee, to form military gasoline cans. (*Photo Courtesy Milwaukee Sentinel*)

VERSON ALLSTEEL PRESS CO., Chicago and Dallas
MECHANICAL AND HYDRAULIC PRESSES AND PRESS BRAKES • TRANSMAT PRESSES
TOOLING • DIE CUSHIONS • COMPRESSION AND TRANSFER MOLDING PRESSES

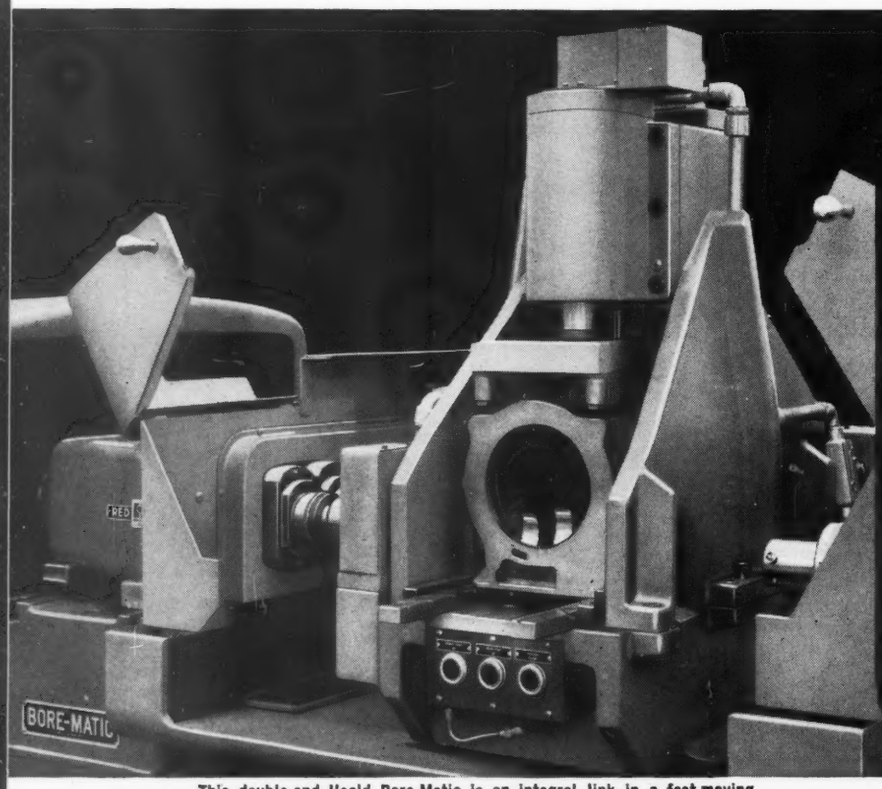


When production lines shift to defense, the PROVED DEPENDABILITY of Heald machines helps to KEEP 'EM ROLLING

There's no room for weak links in the chain of operations that makes up your production line — especially when you're tooling up for vital defense orders. That's where Heald's extra dependability and proved precision can help you off to a good start — and keep production rolling around the clock.

The new Heald Bore-Matics and grinding machines have won their service stripes in the most competitive fields of highly mechanized production — setting enviable records for speed, efficiency and dependability. This background of proved performance — plus Heald's unequalled engineering experience in all fields of precision finishing — can smooth the way for faster, easier conversion, and *sustained production* that will meet the most exacting requirements.

Remember — when it comes to precision finishing, it pays to come to Heald.



This double-end Heald Bore-Matic is an integral link in a fast-moving automotive conveyor line, borizing cross holes in transmission housings.

Heald Bore-Matic Setup Increases Efficiency of Automotive Conveyor Line

HERE'S WHY

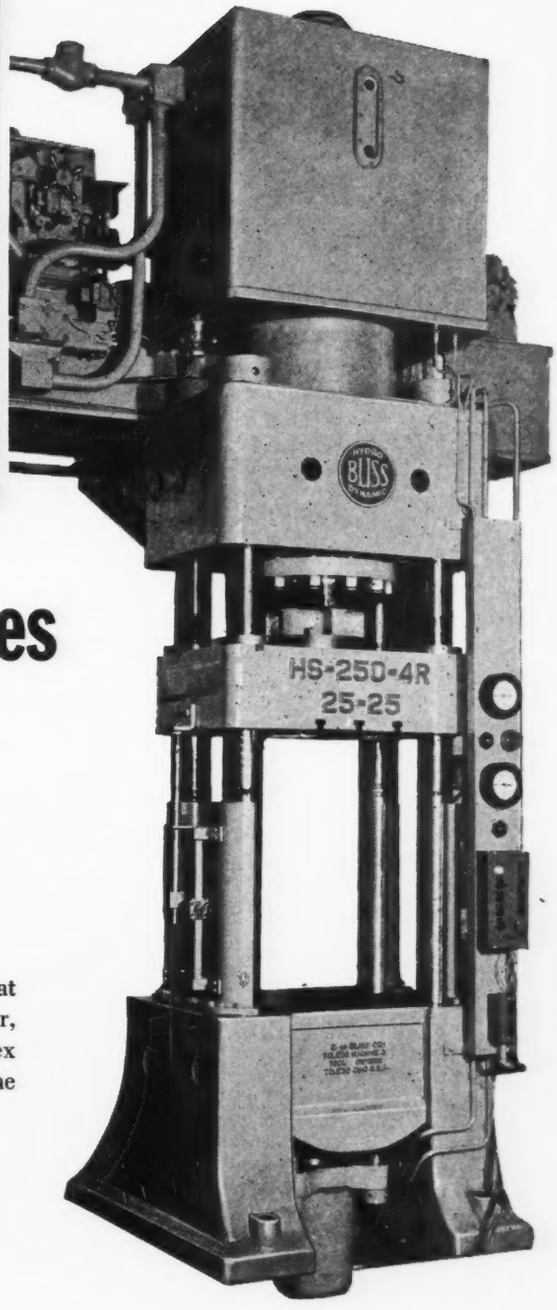
1. **Basic Dependability** — sound design and reliable cycle functions provide the maximum in uninterrupted production.
2. **Correct Working Height** — combines ease of operation and loading with required level for conveyor setup.
3. **Convenient Operation** — automatic operating cycle and fixture equipment controlled by push buttons.

HEALD

THE HEALD MACHINE COMPANY

WORCESTER 6, MASSACHUSETTS

Branch Offices: Chicago • Cleveland • Dayton • Detroit • Indianapolis • New York



8 Bliss Hydraulic Presses form iron powder into complex turbine blades

Intricate aircraft turbine blades, particularly complex due to the great change required from body to root, are molded from iron powder, coined and straightened in special Bliss hydraulic presses with duplex actions at Thompson Products, Inc. Thompson's engineers credit the process and Bliss presses with these advantages:

(a) *Conserving critical metals and materials*

(b) *Minimizing machining requirements*

(c) *Holding tolerances to ±0.003 in. to airfoil contour... ±½ degree of twist*

(d) *Excellent tool life—tool steel dies deliver up to 250,000 parts*

(e) *Require relatively light pressures*

Features of the Bliss hydraulic presses include dual flow pumps, rapid advance and return speeds, variable pressing speeds, automatic reversal, automatic speed change, overload protection, plus numerous other safety devices and construction refinements.

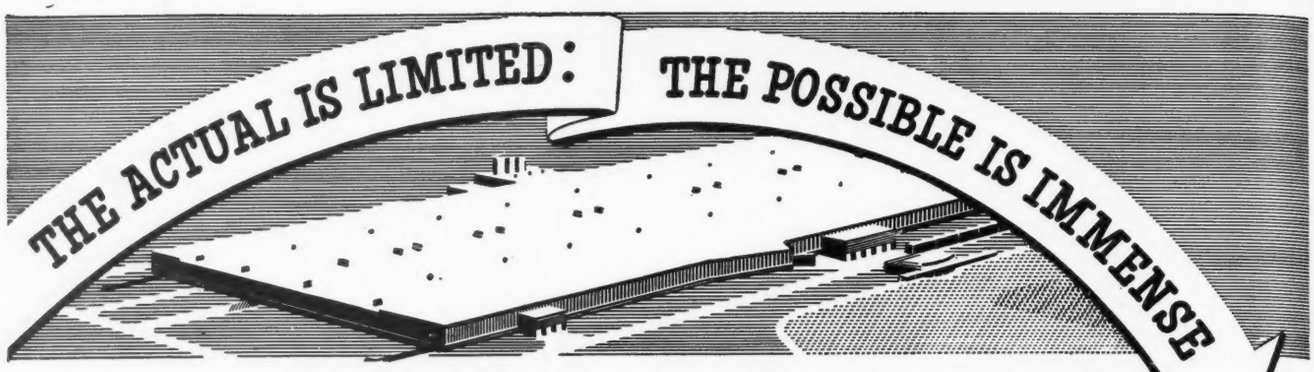
Bliss has led the way for years in the development of presses to form metal powders...has installations in leading plants using the technique. This experience is yours when you call on Bliss with your equipment problems.

E. W. BLISS COMPANY, Canton, Ohio

Mechanical and Hydraulic Presses, Rolling Mills, Container Machinery

From a Single Press for a Given Job...to a Complete Press Room...

It's Bliss



NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

© LE Co. 1951

SAVES 94% WITH WELDED STEEL

Machine designs that utilize the economies of welded steel are always lower in cost. As shown in the development of this typical machine part, substantial production savings are possible because:

Steel costs less per pound and fewer pounds are needed. The initial cost-saving advantage is 7 to 1 with steel, considering strength and safety factors alone.

Approaches to efficient product shape are endless. Stronger materials themselves can be more easily concentrated in the load-carrying areas, giving greater strength, more rigidity per pound of metal. Unlimited combinations of steel shapes can be utilized, enabling lower cost manufacture with a minimum of shop equipment.

Get the facts now. Your Lincoln Welding Engineer will show how your products can be fabricated with less metal and at lower cost. Simply call or write.

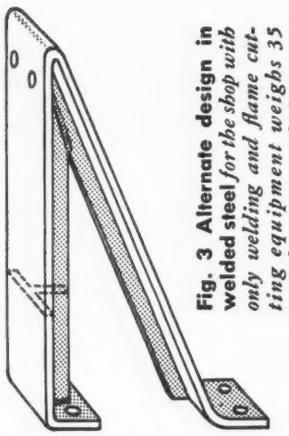


Fig. 3 Alternate design in welded steel *for the shop with only welding and flame cutting equipment weighs 35 pounds . . . costs only $4.70 . . . a saving of 48% over Figure 1.*

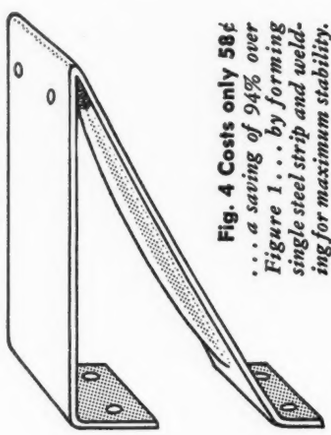


Fig. 4 Costs only 58¢ *. . . a saving of 94% over Figure 1 . . . by forming single steel strip and welding for maximum stability. Weighs only 9 pounds.*

the ACTUAL

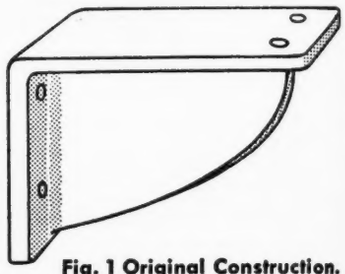


Fig. 1 Original Construction. *Machinery bracket weighs 39 pounds. Has ¾" and ⅜" sections. Requires milling and drilling. Costs $9.10.*

increasing the YIELD

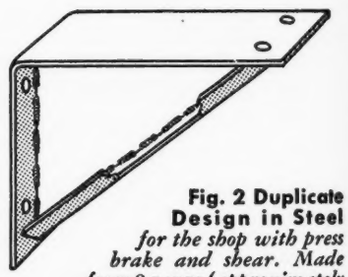


Fig. 2 Duplicate Design in Steel *for the shop with press brake and shear. Made from 8 gauge (approximately ⅛") sheet . . . saves 27 pounds of metal.* Costs $5.13 less than original construction.

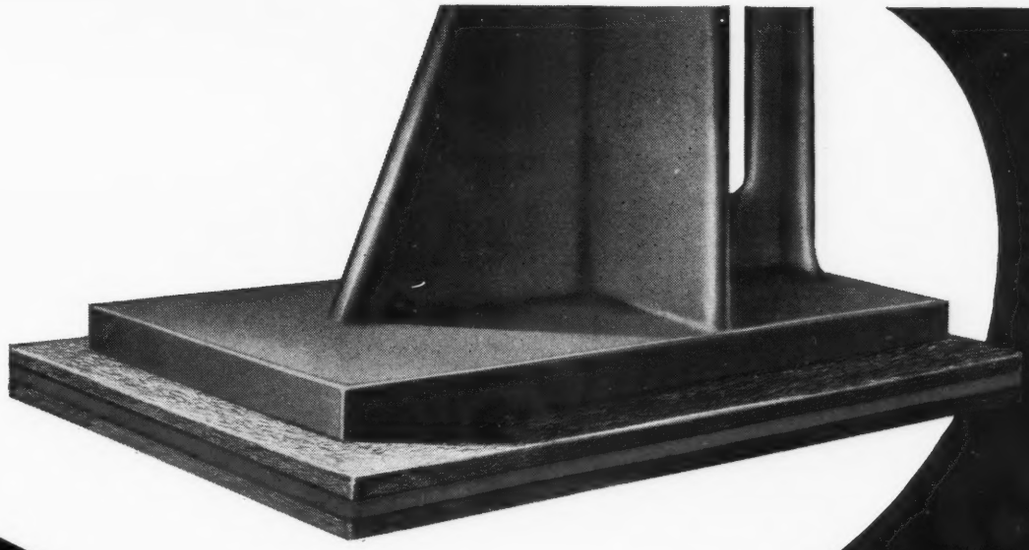
the IMMENSITY of the POSSIBLE a saving of 56% in cost

PROGRESSIVE DESIGN CUTS COSTS FURTHER

Machine Design Studies available to designers and production men. Write on your letterhead to Dept. 27,

THE LINCOLN ELECTRIC COMPANY

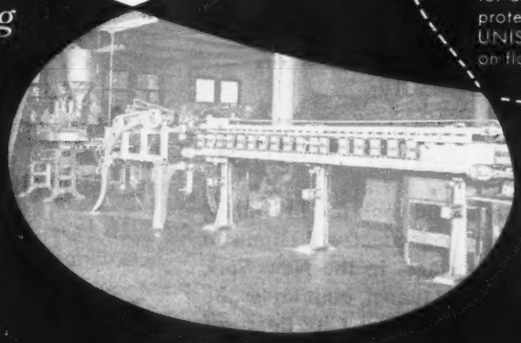
CLEVELAND 1, OHIO



No Floor Drilling

When You Mount Machinery on

UNISORB®



Pneumatic Scale Packaging Maching mounted on UNISORB at River Brand Rice Company, New York: a fine example of how UNISORB'S elimination of the need for anchoring-bolts and lag screws protects the value of plant floors. UNISORB is equally effective on flooring of every kind.

Old-fashioned, destructive floor drilling is gone . . . for good . . . when you anchor your machinery the modern way, on UNISORB.

UNISORB-Mounting requires no bolts, no lag screws. A special cement (we supply it) grips the machine foot to the UNISORB pad and tightly bonds the pad to the floor with a *minimum* holding strength of 5000 lbs. per square foot. *And installation time is shortened — saving man-hours and money.*

Moreover, UNISORB-Mounting eliminates 60-85% of all transmitted machine noise and vibration . . . which means prolonged machine life, as well as a lessening of stress on floors and buildings . . . and quieter working conditions for improved efficiency and morale.

Don't you agree that now, of all times, you should

Get the Facts

ALL the Facts on Unisorb TODAY

The
FELTERS COMPANY
210-P SOUTH STREET
BOSTON 11, MASS.

Offices: New York, Phila., Chicago, Detroit, St. Louis

Sales Representative: San Francisco

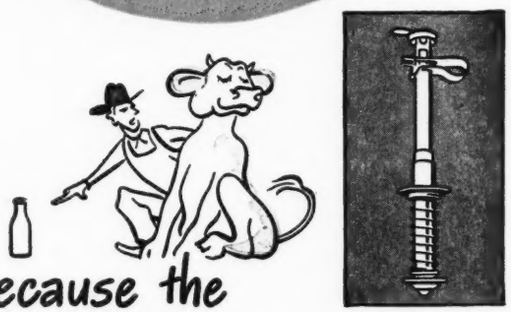
Mills: Johnson City, New York; Millbury, Mass.; Jackson, Mich.; New York City

Distributors in Principal Cities Throughout the World

ANACONDA METALS at work

Pictures "come to life"

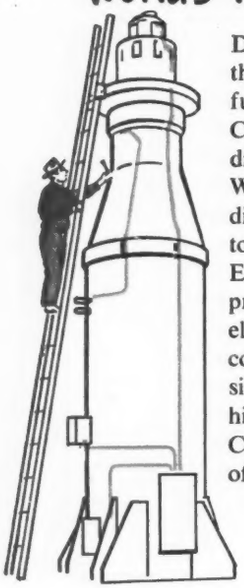
Ever look through an old-time stereoscope? Remember the fascination of three-dimension pictures? Now add the vivid, full-color of Kodachrome and you have an idea of the breathtaking realism made possible with a View-Master Stereoscope—price, two dollars retail—anywhere in the U.S.A. But there's a lot of close-fitting, smooth-operating brass stampings in this device, and, when they're made at the rate of a million a year, there's no time for fussing with off-gage, off-temper metal. Anaconda Brass is the choice of Sawyer's Inc., Portland, Oregon, makers of the View-Master.



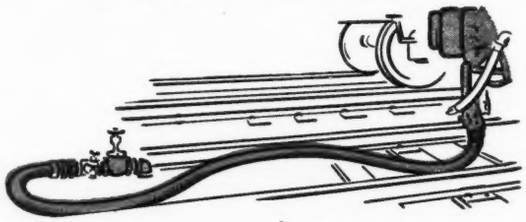
Because the cow won't cooperate

This unique milk-bottling valve features an air release tube telescoped into a second larger tube. Advantage: Fast air venting speeds up the bottle-filling operation. Anaconda Nickel Silver was selected for the most important parts because this silvery-white metal is attractive, readily workable, easy to clean—and keep clean. The Specialty Brass Company, Kenosha, Wisconsin, manufactures the Kleen-Fill Valve.

World's longest water tunnel



Driven through solid rock for 117 miles, this underground aqueduct will eliminate future water shortages in the New York City area. The new tunnel, built under the direction of the New York City Board of Water Supply, measures up to 21 feet in diameter and extends from the Catskills to New York City. Thousands of feet of Everdur Electrical Conduit are used to protect important control wiring for the electric sluice gate hoists, pumps and recording devices. Junction boxes in corrosive locations are also made of one of the high-strength, corrosion-resistant Everdur Copper-Silicon Alloys. Write for a copy of Publication E-12.



An "American" short story on railroading

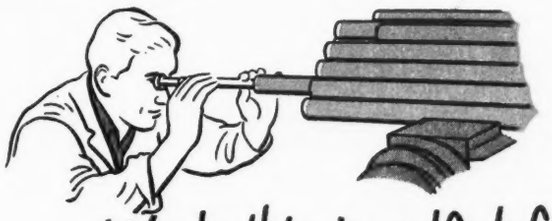
Many of our railroads have found a simple, economical answer to the problem of supplying live steam to cars and coaches standing on sidings or in railroad terminals waiting for a locomotive to hook on. It's in the form of "American" Flexible Metal Tubing. No joints to repack—simple to connect and disconnect, they save dollars in steam and maintenance expense. There are thousands of other applications where "American" Flexible Metal Hose or Tubing is used to convey steam, oil, air and other liquids and gases. Catalog CC-300 tells all. Want a copy?

PS

With the rapid changeover facing American Industry today, much time can be saved by getting the right answer, quickly, to new metalworking problems. The service files of our Technical Department represent many years of experience with the metalworking field and contain much practical information on copper and copper alloy applications. If you feel we can help, don't hesitate to write, addressing The American Brass Company, Waterbury 20, Connecticut.

Jack of all cars

Ever have trouble changing a flat on that low-slung car of yours? Well, here's a jack that eliminates the headache. Made by the Triangle Jack Co., Inc., of Wichita, Kansas, it can be instantly adjusted to suit the road clearance of any car. An Everdur Copper-Silicon Alloy is used for an important part of the screw mechanism because the manufacturer found it stronger, tougher and generally superior to all other nonferrous metals tried.



We do this in self-defense

For many years our French Small Tube Branch has manufactured small diameter, thin-gage tubes of the highest accuracy commercially obtainable. One of the reasons for this is the constant use of the bore telescope on redraw stock . . . for a *small* defect in a large tube would mean a *large* defect in a small tube. Since a tube with an imperfect bore could not escape our final tests and inspection, it would be rejected and scrapped . . . hence, we have a mighty good reason for ferreting out any possible imperfections right at the start.

What's so fascinating about a fire hydrant?

It all depends on the point of view. To the city engineer it's a comforting thought to know the manufacturer used the right metal in the right place. The stem, for instance, is one of the most vulnerable parts of a hydrant. It is subject to unusual stresses, strain and corrosive attack—and it has to be there when you need it! Leading hydrant manufacturers are using Everdur Copper-Silicon Alloys in increasing quantities for stems, stem-nuts, seat rings, drip valve holders, washers, bolts, barrels and other parts where a strong, tough, corrosion-resistant metal is required.

No chance for replacement here

Expansion and contraction are important problems in bridge and highway construction. A bearing surface capable of supporting the tremendous, shifting weight of the superstructure must be provided. Bridge plates of Anaconda Rolled Phosphor Bronze, one of the best bearing metals known, have been installed in many of the country's largest structures, including the Macombs Dam Bridge approach of the Major Deegan Expressway, New York City. Fabricated with graphite-lubricated inserts in trepanned grooves by Merriman Brothers, Inc., Boston, and used in conjunction with a rocker assembly, these Anaconda Bridge Plates will withstand lateral movement in any direction from now on.

YOURS—FOR THE FIRST TIME!

25 years of corrosion-resistance data ...in 24 pages

This brand new booklet is the first of its kind in the brass industry. It explains the chemical and physical nature of corrosive attack in its various forms. Included is a tabulation indicating the relative corrosion resistance of the principal types of copper and copper base alloys when in contact with 183 different corroding agents frequently encountered. A penny post card will bring your copy of Publication B-36. Address: The American Brass Company, Waterbury 20, Conn.

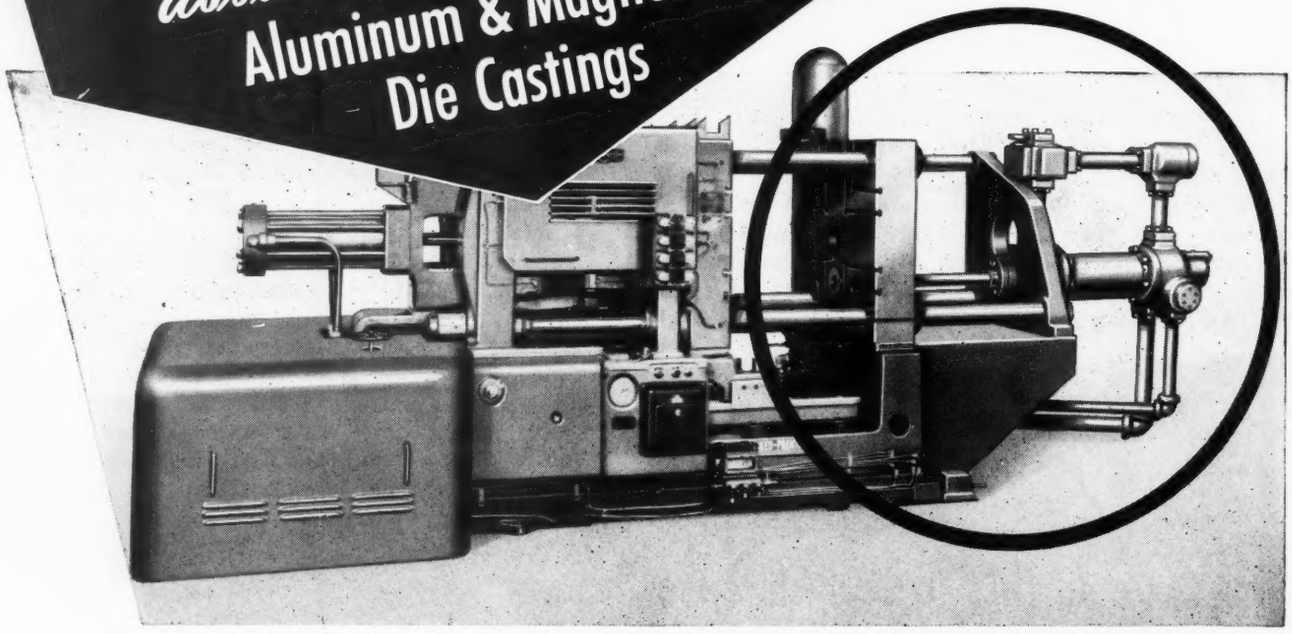
ANACONDA

the name to remember in

COPPER·BRASS·BRONZE

51103

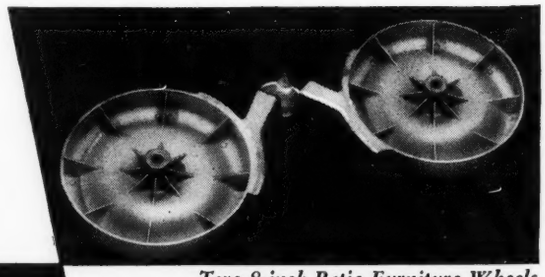
New Reed-Prentice Process *assures Higher Quality* Aluminum & Magnesium Die Castings



Reed-Prentice #2G "Cold Chamber" Die Casting Machine with New Prefill Attachment.

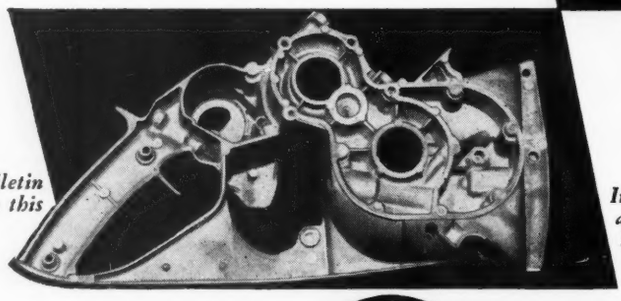
● By its constant in-the-field research, Reed-Prentice has developed a special die casting process that produces higher quality aluminum and magnesium parts faster — more economically — and more efficiently.

Through a new prefill arrangement and much faster "shot" plunger speed — up to 10,000 inches per minute — Reed-Prentice Models 1½G and 2G "Cold Chamber" Machines now offer even greater advantages in die casting aluminum and magnesium.



Two 8-inch Patio Furniture Wheels Die Cast of Aluminum on Reed-Prentice #1½G Machine by W. L. Chapman Co., Pasadena, Calif. Complete shot weighs 3½ lbs. and has projected area of 103 sq. in.

Write Dept. B for new bulletin giving complete details on this important die casting development.



Intricate Magnesium Body for Portable Chain Saw produced on Reed-Prentice #2G Die Casting Machine by McCulloch Motors, Los Angeles, Calif., weighs 2½ lbs.

MAIN OFFICE
677 Cambridge St., Worcester 4, Mass.

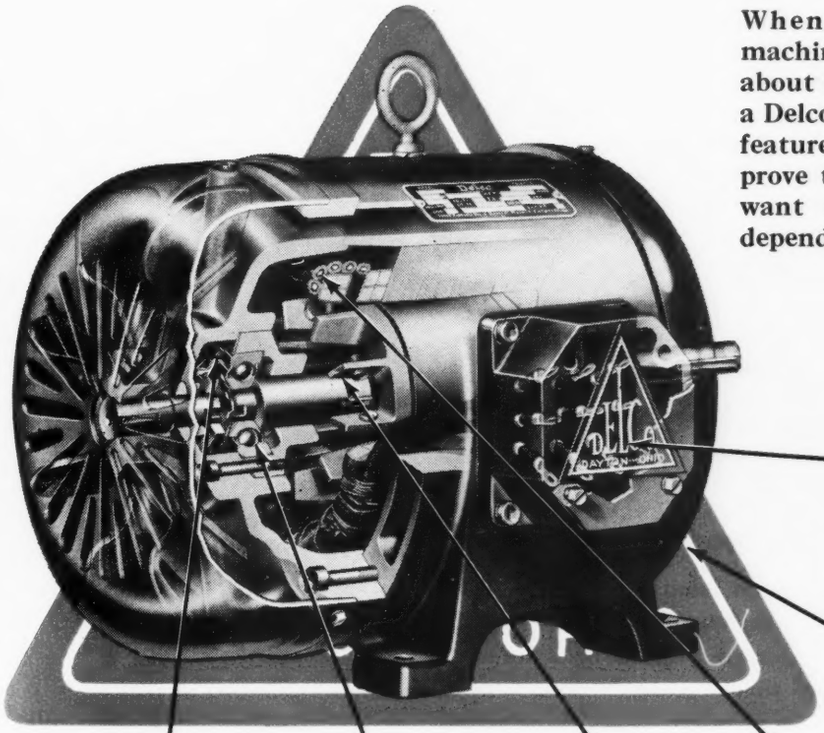
BRANCH OFFICES
75 West St., New York 6, N. Y.
1213 West 3rd St., Cleveland 13, Ohio
2400 W. Madison St., Chicago 12, Illinois
2314 Santa Fe Ave., Los Angeles 58, Calif.

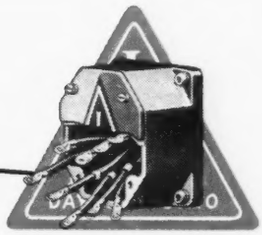
DIE CASTING
REED-PRENTICE CORP.
WORCESTER MACHINES MASS., U.S.A.

REPRESENTATIVES:
Detroit ..... Kordenbrock Machinery Co.
Grand Rapids ..... Joseph Monahan Co.
Syracuse ..... J. F. Owens Machinery Co.
Houston ..... Preston Machine Tool Sales Co.
Seattle & Spokane ..... Star Machinery Co.
Minneapolis ..... Chas. W. Stone Co.

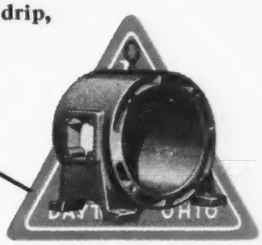
Here's the "INSIDE STORY" on DELCO MOTORS

When you invest in new production machinery, it pays to be just as particular about the motor that drives it. Look inside a Delco Motor. You'll see extra engineering features, extra care in construction, that prove to you a Delco is built the way you want a motor built. Specify Delco for dependable power day in, day out.





WATER-TIGHT CONDUIT BOX
Protects against drip, splash

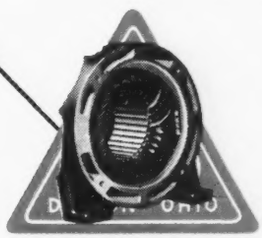


CORROSIVE-RESISTANT CAST IRON FRAME
More solid, more rugged

POSITIONED BEARINGS
Maintain shaft alignment

POSITIVE LUBRICATION
Lengthens bearing life

DYNAMICALLY-BALANCED ROTOR AND SHAFT ASSEMBLY
Reduces vibration, wear



DELCOTE COIL INSULATION
Over and above NEMA specifications

"DELCO PREFERRED"
—because Delco Delivers

Open and enclosed motors for most industrial applications in sizes up to 100 horsepower for standard foot mountings. NEMA C&D flange-mounted motors available in sizes through 30 horsepower. Get in touch with Delco Products, Dayton, Ohio . . . or any sales office listed below.

DELCO MOTORS

DELCO PRODUCTS

Division of General Motors Corporation, Dayton, Ohio

SALES OFFICES: Chicago • Cincinnati • Cleveland • Dallas • Detroit • Hartford • Philadelphia • St. Louis

ALSO AVAILABLE THROUGH DELCO MOTOR DISTRIBUTORS

They never miss this HEADLINE

and the savings in time — and screws — make news wherever they see it on P-K Size-marked Gear Grip Socket Head Cap Screws

The SIZE-MARK on Parker-Kalon Socket Head Cap Screws is something no workers can miss, whether they are beginners or veterans.

When they see it, errors and confusion are avoided. Sizes are issued correctly, used correctly—there's no time wasted checking and changing, no spoiled work.

In the tool-crib, the P-K Size-mark speeds up sorting of left-over, mixed screws, without the bother of "miking" or gauging. It puts screws back in use that might otherwise be discarded because sorting is "too much bother".

Only Parker-Kalon offers the Size-mark and Gear Grip on Cap Screws. They are wanted, in tremendous quantities, for more of industry's finest products than ever before. For DO or other assemblies, set your standards by P-K quality. Your P-K Distributor will apply his long experience to your most difficult problems of planning and procurement.

IF IT'S P-K IT'S O.K.

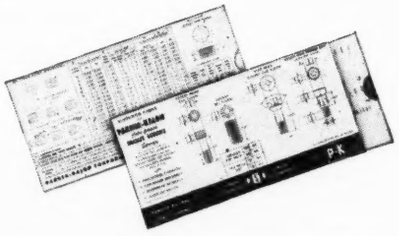
Parker-Kalon Corporation, 202 Varick Street, New York 14, New York.
Sold through Accredited Distributors.

PARKER-KALON®

Cold-forged

SOCKET SCREWS

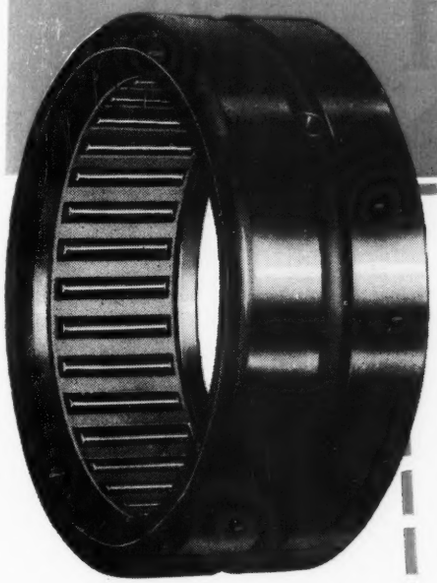
SIZE-MARKED SOCKET HEAD CAP SCREWS • GROUND THREAD SOCKET SET SCREWS
FLAT HEAD SOCKET CAP SCREWS • STRIPPER BOLTS • PIPE PLUGS • HEX KEYS



MORE HELP FOR ASSEMBLY PLANNERS

The New
P-K Socket Screw Dimension Finder

A pocket-size plastic slide chart gives you all essential dimensions of P-K Socket Cap Screws, Set Screws, Flat Head Socket Cap Screws, Stripper Bolts, and Pipe Plugs. Includes Set Screw Point Dimensions, and Thread Length Formula. Available, FREE from your P-K Distributor.

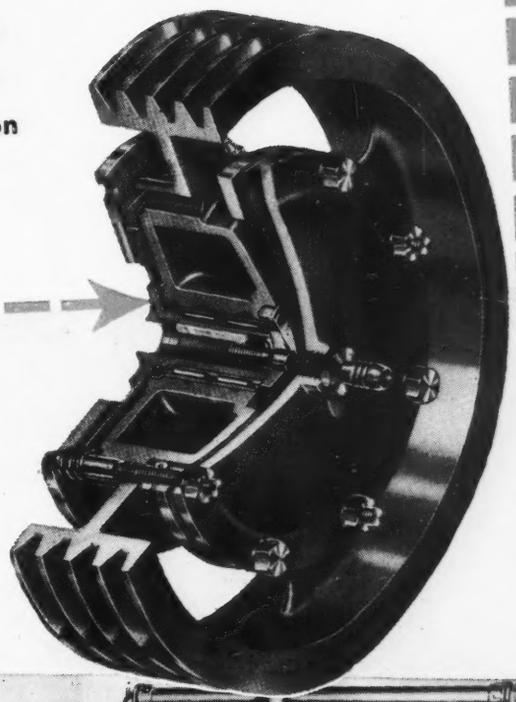


ORANGE *Cage Type* NEEDLE BEARINGS

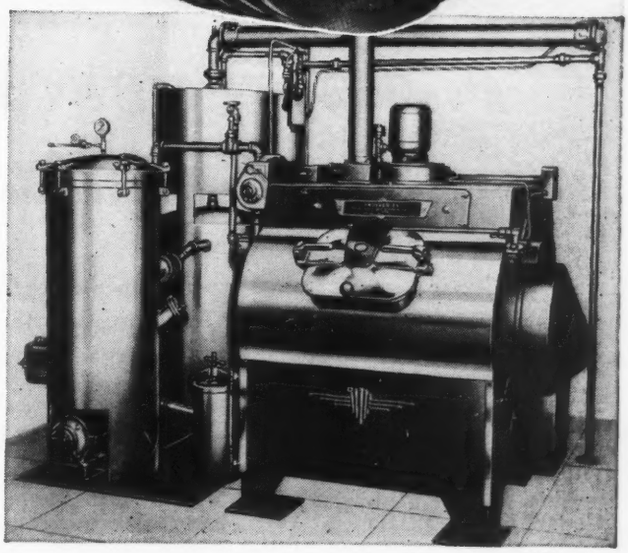
—used in Clutch Disc Sleeve of

PROSPERITY DRY CLEANING MACHINE

Close tolerances and rugged construction provide quiet operation and friction-free protection



● In Model 6A Prosperity Dry Cleaning Machines, the Pneumatic Diaphragm Clutch is engaged during the washing operation and disengaged during the extraction operation. At the shift, clutch locks the "V" pulley and power is transmitted through the keyed Extractor motor shaft. The clutch disc sleeve for this shaft is mounted on a double-row Orange Cage Type Needle Bearing with inner race to prevent linear creep. The Prosperity Co., Inc., Syracuse, N. Y., has been using these bearings for seven years, with highly satisfactory results.



Exclusive cage design holds rollers in permanent alignment—prevents skewing—permits precision-controlled internal clearances.

Orange Cage Type Needle Bearings are serving with great success in spindles—vertical installations—overhung mountings and relatively high speed applications. They are less affected by misaligned mountings and uneven loadings. They are unequalled where extreme precision and quiet, smooth running are essential. Yet, with all these features, they provide high load-carrying capacity in limited space, plus a "bonus" of Pentrate-finished raceways and rollers for increased resistance to corrosion and friction.

WRITE FOR ENGINEERING DATA FOLDER on Cage Type Needle Bearings, showing construction, advantages, dimensions, capacities, etc.

ORANGE ROLLER BEARING CO., INC., 552 Main Street, Orange, N. J.

reduce assembling and maintenance time

If your production line, or plant maintenance calls for nut application or removal you'll find just the right wrench in the CP line of reversible air impact wrenches.

Powerful, compact, perfectly balanced, and with no twisting thrust to fatigue the operator, CP wrenches speed operations and cut costs.

Capacities range from $\frac{1}{4}$" to $1\frac{3}{4}$" bolt size, and angle head models are available to reach awkwardly located nuts, bolts and studs. Power regulators, for control of tightness, are available on all models up to $\frac{3}{4}$" bolt size.

Write for a copy of Bulletin 812

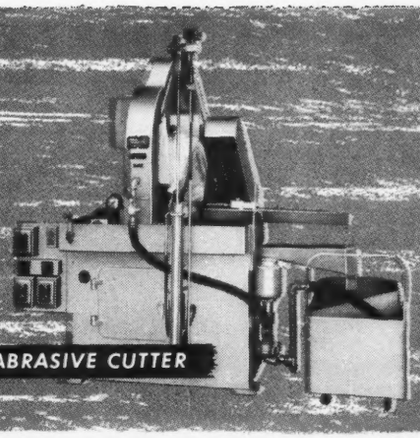
CAPACITIES—BOLT SIZE

CP-337	$\frac{1}{4}$"
CP-344	$\frac{3}{8}$"
CP-3440	$\frac{3}{8}$", heavy duty
CP-349	$\frac{3}{8}$"
CP-360	$\frac{3}{4}$"
CP-3630	$\frac{3}{4}$", heavy duty
CP-365	$1\frac{1}{4}$"
CP-375	$1\frac{3}{4}$"

CHICAGO PNEUMATIC TOOL COMPANY
General Offices: 8 East 44th Street, New York 17, N. Y.

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES
ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

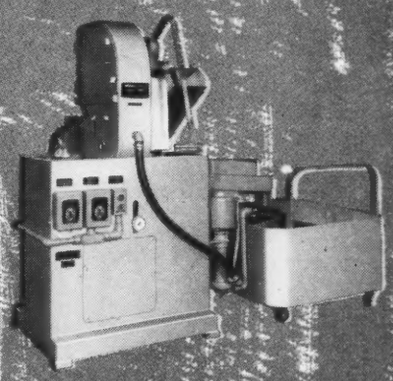
Try this Better, Cheaper Way to Cut—



MODEL 406 ABRASIVE CUTTER

CAMPBELL ABRASIVE CUTTERS

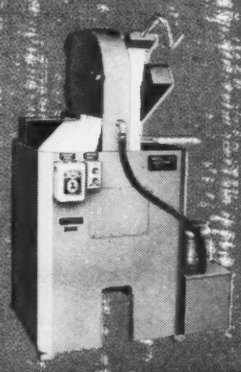
Abrasive cutting saves time. It usually saves a finishing operation because the cut ends are smooth and practically burr free. The abrasive wheel cuts through hardened or annealed steel, non-ferrous metals, plastics, too. Length of cut is controlled to within a few thousandths of an inch.



MODEL 223 ABRASIVE CUTTER

Safer to Use CAMPBELL ABRASIVE CUTTERS are safer to use because cutting wheels are enclosed in steel. Work clamp, work stop, and coolant pump are automatic. Coolant is distributed equally over work. Wheels last longer, quality cuts are produced.

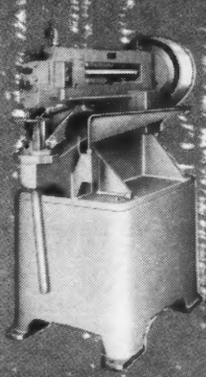
Choice of Styles There are sizes and styles of Campbell Abrasive Cutters for every job. All are completely re-engineered for production performance . . . ready for the emergency.



MODEL 15 ABRASIVE CUTTER

AND . . . CAMPBELL NIBBLERS

Cutting odd shapes from sheets of ferrous and non-ferrous metals is quick and inexpensive on a CAMPBELL NIBBLER. A rapid circular punch and die take "bites" out of sheet guided by operator. Work feeds in any direction. Any shape of hole can be cut in center of sheet without cutting perimeter. 40 to 60 times faster than drilling and filing.



MODEL 2524 NIBBLING MACHINE

***YOU TELL US**—Campbell has the machines—Abrasive Cutters and Nibblers. You tell us what your job is. We'll send literature and make recommendations.*

Ask for your copy of Bulletin DH-171

ACCO

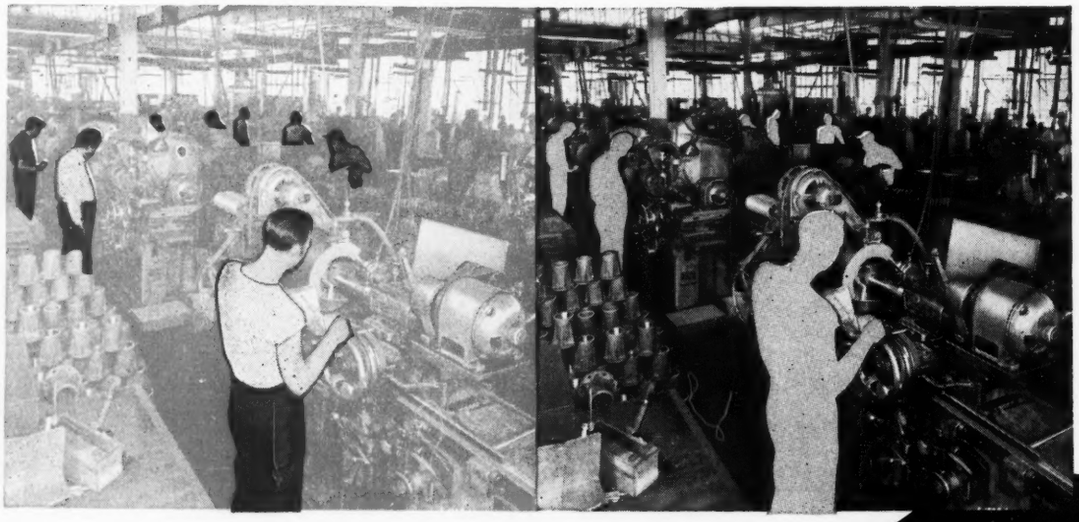
TRADE MARK

CAMPBELL MACHINE DIVISION
AMERICAN CHAIN & CABLE

925 Connecticut Ave., Bridgeport, Conn.

CAMPBELL Abrasive Cutters AND Nibblers

the SKILL *the* FACILITIES



. . . *to deliver* TRUE PRECISION *in Parts Such As These*

When many of the country's largest and most prominent manufacturers require hardened and precision ground parts that must adhere rigidly to quality specifications and meet every precision requirement, they rely on Allied to produce them. They *know* that, no matter how difficult or in how high a volume the parts may be . . . regardless of the number of operations involved . . . Allied has the personnel and equipment to do the job right, economically and on time.

Other
ALLIED PRODUCTS

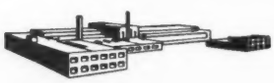
SPECIAL COLD FORGED PARTS
STANDARD CAP SCREWS • SHEET METAL DIES FROM THE LARGEST TO THE SMALLEST • ALLITE ZINC ALLOY DIES • JIGS • FIXTURES
R-B INTERCHANGEABLE PUNCHES AND DIES

PRECISION • EXPERIENCE • DEPENDABILITY
ALLIED CORPORATION PRODUCTS

ALLIED PRODUCTS CORPORATION

DEPT. D-1 • 12619 BURT ROAD • DETROIT 23, MICH.

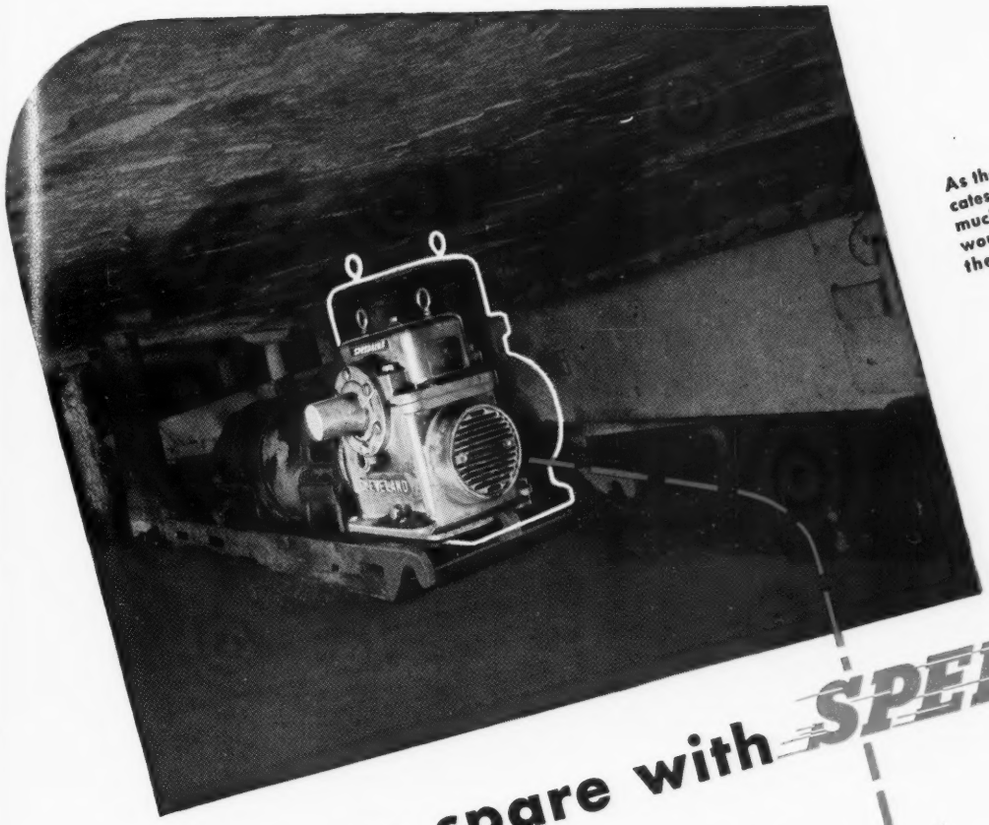
PLANT 1
Detroit, Mich.



PLANT 2
Detroit, Mich.

PLANT 3
Hillsdale, Mich.

PLANT 4
Hillsdale, Mich.



As the white outline indicates, a standard unit of much greater frame size would be required to do the work of Speedaire.

Clearance to spare with SPEEDAIRE

SPEEDAIRE is the only practicable worm gear drive for this portable coal conveyor. A standard unit of comparable capacity, being 7½" taller, would not clear this 36" ceiling. It could not be used in many parts of the mine. The conventional drive also weighs a third more than Speedaire and requires a heavier mounting, making the conveyor less easy to move. Dollar-wise, Speedaire saved $130.

Speedaire is Cleveland's fan-cooled worm-gear speed reducer. Because it is fan-cooled, Speedaire will do more work—delivering up to *double the horsepower* of a standard worm unit of equal frame size, at usual motor speeds. It can be installed economically on many applications where other types have been used heretofore—providing the advantage of a compact right-angle drive. Speedaire gives the same long, trouble-free service for which Clevelands are famous.

For description, send for Catalog 300. The Cleveland Worm & Gear Co., 3276 East 80th St., Cleveland 4, Ohio.

Affiliate: The Farval Corporation, Centralized Systems of Lubrication. In Canada: Peacock Brothers Limited.

CLEVELAND
Worm Gear
Speed Reducers

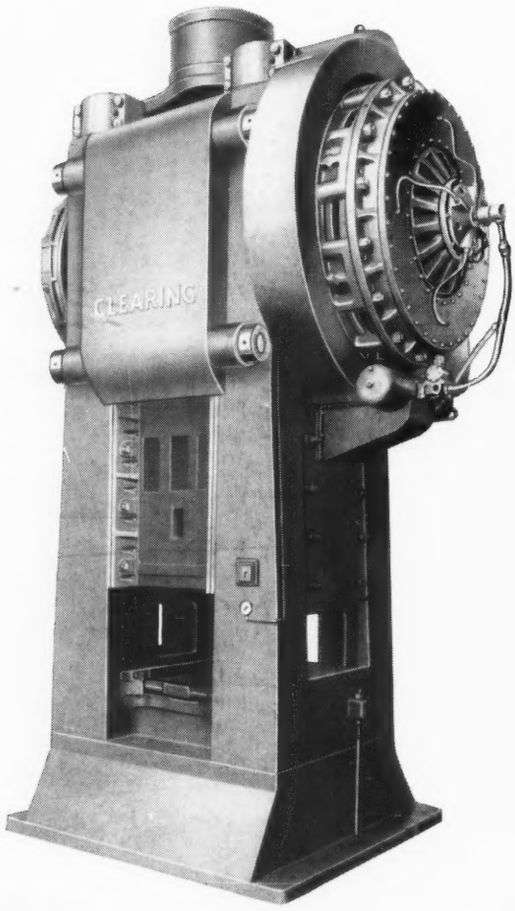
Announcing

the NEW improved

FORGING PRESSES

SERIES EF

by CLEARING...



Faster production in forging or cold coining operations, using less skilled labor yet holding ever closer tolerances in output—that's what manufacturers for defense or civilian needs are demanding today. Clearing meets those demands —all of them—with its new Series EF presses, which incorporate many improvements over previous Clearing forging presses.

Short-travel disc clutch and brake act faster to speed operation. Offset eccentric allows continuous guiding of extra long slide to assure maximum precision. Coordinated knockouts minimize contact time to keep dies cooler, longer lasting.

We can't tell the whole story here, but we'll gladly supply details at your request.

CLEARING MACHINE CORPORATION

6499 WEST 65th STREET • CHICAGO 38, ILLINOIS

CLEARING PRESSES

THE WAY TO EFFICIENT MASS PRODUCTION

CMC CLEARING

ing
ing
hat
are
nds
ses,
pre-

to
nu-
xi-
ize

e'll